Prince Edward Island
CANADA

PRINCE EDWARD ISLAND

PROVINCIAL ENERGY STRATEGY 2016/17

Overview - Prince Edward Island Energy Strategy

The Government of Prince Edward Island has developed a 10-year strategy to reduce energy use, establish cleaner and locally produced energy sources and moderate future energy price increases. The goal of the strategy is to develop a stronger, more sustainable and energy independent province. It will focus on three vital areas: efficiency, conservation and renewables.

The strategy is based on recommendations from Dunsky Energy Consulting and extensive consultations with individuals, businesses and organizations. The strategy was developed following three guiding principles: reducing greenhouse gas emissions; implementing cost-effective actions and decisions; and creating local economic opportunities.

A recent study found that gains in energy efficiency result in a higher GDP, increased employment and greater competitiveness. Energy efficiency also reduces the burden on existing energy infrastructure and the need for costly upgrades; reduces the energy burden of vulnerable populations; and reduces greenhouse gas and other emissions.

The energy strategy's effect on PEI's economy is two-pronged. One, it will result in energy savings for Islanders and create greater self-sufficiency by reducing our reliance on imported fossil fuels. Two, it will create new employment and economic opportunities through retrofitting projects and the generation of more locally-produced energy.

The Prince Edward Island energy strategy is also aligned with the Provincial Climate Change Mitigation Recommendations.

Every Islander has a role to play in creating a more sustainable energy future. Through robust education and engagement, and through outreach activities, Islanders will be provided with the information and resources they need to become more energy efficient and to conserve more energy. A mix of voluntary actions, incentives and other required changes will provide the foundation for a more secure and sustainable energy future.

Energy efficiency and conservation

The cheapest energy is the energy we don't use. Island homeowner's spend on average close to $3,500 on energy for their homes every year. This number could be significantly reduced by implementing cost effective energy efficiency and conservation measures. Energy efficiency and conservation will benefit the provincial economy and individuals and businesses. The cost of imported energy, based on today's prices, is currently $465 million, or 36 per cent of the province's $1.3 billion trade deficit. Reducing energy use will help address that deficit, thus, energy efficiency and conservation is the top priority. The goal is to achieve savings of two per

cent of electrical and non-electrical consumption per year by 2020. This will be achieved through a reduction in energy use and peak demand.

To that end, the mandate of efficiencyPEI will be expanded with a broad multi-fuels mandate. Peak-reducing demand side management programs will be transferred to efficiencyPEI. As well, efficiencyPEI will manage a comprehensive suite of programs and formalize energy efficiency targets. These programs include energy retrofits for homes and businesses, new construction and providing incentives for more energy efficient appliances and equipment. Energy storage initiatives (including hot water heaters and other thermal storage devices) can also be important contributors to reducing peak demand.

Specific programs will be implemented to assist low to moderate income Islanders with the adoption of energy efficient practices. Access to these programs will be simplified and provided by one entity, efficiencyPEI, responsible for efficiency programs for all fuel types.

Although the initial draft of the energy strategy recommended the HST exemption on fuel oil be eliminated, the Province will not implement the recommendation at this time. It is important that Islanders be first given an opportunity to reduce their energy use and reliance on fossil fuel.

In order to encourage conservation in new construction, the National Building Code and the National Energy Code for Buildings will be implemented on a province-wide basis. To further promote energy efficiency, a "stretch" code will be implemented to further increase the standards.

Energy retrofits and other related activities will create new economic and employment opportunities for Islanders. According to the Canadian Green Building Council, the market for retrofits is vigorous and growing. Training and other initiatives will ensure that Islanders can acquire the expertise and experience to grow this emerging sector.

Power generation and management

Prince Edward Island is already a leader in the generation of wind energy. Approximately 25 per cent of the province's electrical needs are met by wind, the highest percentage of any jurisdiction in North America. One of the priorities of the new energy strategy is to increase electrical production from this source. To achieve this goal, we will explore federal government funding to expand wind energy production. The proposed projects include a new 30 MW wind project in 2019 and a further 40 MW project in 2025.

In conjunction with this, we will explore and develop relationships with transmission and generation project partners to enable the province to take advantage of potential future export opportunities. The expanded cable connection with the mainland will help achieve this goal.

There is significant research and development capacity in the province. The Wind Energy Institute of Canada, the UPEI School of Sustainable Design Engineering and the Holland College

Energy Systems Engineering Technology program offer opportunities to partner on research and development. Through these and other resources, the energy strategy will monitor advances in storage technologies.

At the same time, given advances in solar technologies and the trend to lower production costs, the potential for utility-scale solar generation will be explored, along with financing options for the installation of solar panels on residences and businesses. In addition to utility-scale generation, the new energy strategy will also explore opportunities for distributed generation in which individual sites generate all or most of their energy requirements.

The use of smart grid technology enables utilities to allow for a future time-of-use billing system. This could allow for pricing that encourages electrical consumption during periods of high wind power, while contributing to the goal of reducing peak demand.

A related issue is the need for an appropriate communications system for smart grids. Research will be conducted into options for integrating the communications requirements of smart technology for utility customers.

Biomass and heating

The provincial government has installed a number of wood heating systems in public buildings across the Island. This helps reduce the use of fossil fuels and the level of greenhouse gas emissions. Since the first systems were installed in 2012, more than three million litres of fossil fuels have been displaced, and the level of greenhouse gases has been reduced by upwards of 7,500 tonnes. Other benefits include more local employment and economic opportunities in wood harvesting and processing, along with sustainably managed forests. Building on this success, under the new energy strategy, the provincial government will explore installing additional wood heating systems at provincial and other public facilities.

Transportation

The transportation sector is by far and away the largest user of fossil fuels in Prince Edward Island and accounts for 42 per cent of greenhouse gas emissions. While other sectors have experienced success in the reduction of fossil fuels, their use in the transportation sector continues to increase. It is vitally important that actions are taken in this sector to reduce the use of fossil fuels and to become more energy efficient.

Under the new energy strategy, a provincial transportation committee will be established. It will be given the mandate and resources to examine and implement energy saving policies. These could include incentives for the purchase of electric vehicles, installation of public charging infrastructure, expansion of cycling lanes and active transportation corridors across the province and the implementation of strategies to make traffic more efficient and reduce energy use.

Consideration will also be given to differential vehicle registration fees based on the size and energy consumption of vehicles and the level of fuel taxes.

One option for government is to begin the electrification of its vehicle fleet.

Leading by example

In adopting a new energy strategy, government clearly recognizes that it too must become more energy conscious in the way it conducts its activities. Under the new energy strategy, we will showcase government as an energy leader. The first steps could include the implementation of sustainability considerations in government procurement decisions. Other measures include launch of a government life-cycle cost approach in which initial costs of construction, for example, are higher but savings will be realized over the long-term. Government will also support pilot projects for highly efficient buildings that pave the way for more aggressive building performance standards in the future. Consideration will also be given to adopting building, emissions or efficiency standards that exceed those presently in place.

A detailed implementation plan is being developed by the Prince Edward Island Energy Corporation and efficiency PEI. Other departments are also involved, along with partnerships with other provincial governments, the federal government, utilities and energy-related businesses and organizations. The implementation plan will also be aligned with the Climate Change Mitigation Strategy which is currently under development.

Prince Edward Island has already made significant progress in energy efficiency and conservation, renewable energy alternatives and economic benefits for the province. This energy strategy will continue to put Prince Edward Island on a path to becoming a world leader in sustainability and energy innovation.

Prince Edward Island 2016 Provincial Energy Strategy

Prince Edward Island
CANADA

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TABLE OF CONTENTS

PRINCE EDWARD ISLAND: WHERE WE ARE, AND WHERE WE SHOULD BE 1

THE 2016 PROVINCIAL ENERGY STRATEGY 3

Stakeholder and Public Input 3
Timeframe 3
Guiding Principles 4
Goals 4
Actions 6
Sectors 6

WHERE WE ARE NOW 7

Prince Edward Island's Electricity System 8
Non-Electric Energy 10
What This Means 12

ENERGY EFFICIENCY AND CONSERVATION 13

Approach to Energy Efficiency and Conservation 14
Administration of Energy Efficiency 16
Residential 18
Commercial, Industrial, and Institutional 20
Geotargeted Energy Efficiency 22
Codes and Standards 22
Demand Response 24

THE ISLAND'S RENEWABLE ELECTRICITY RESOURCES 27

The Island's Electric Grid 27
Wind 27
Wind Energy Exports 29
Tidal 31
Solar 32
Distributed Generation 32
Rooftop and Ground mount Solar 32

ENERGY STORAGE 35

Utility-Scale Energy Storage 35
Batteries 36
Assessing the Economic Value Offered by Energy Storage including Batteries 37
Distributed Storage Opportunities 38
Electric Thermal Storage 38
Grid-interactive Water Heaters 38

BIOMASS 40

Cogeneration 41
Producing electricity from Wood 41

Producing electricity from Biogas 42
HEATING FUELS 43
Wood Chips 43
Firewood 44
Pellet Heating 44
Environmental Concerns 46

TRANSPORTATION **48**

KEY POLICY APPROACHES 49
ELECTRIC VEHICLES 50
Residential Sector 51
Commercial and Institutional Sector 53
BIOGAS 54
COMPRESSED NATURAL GAS 56
MOBILITY MANAGEMENT 57
ENHANCING OUR CULTURE 60

FURTHER CONSIDERATIONS AND OPPORTUNITIES **62**

MUNICIPAL PLANNING REQUIREMENTS 62
PROVINCIAL PROCUREMENT STANDARDS 62
FUEL COST DIFFERENTIAL 63
RATE STRUCTURES 64
GOVERNMENT PLANNING 65

APPENDIX A – CONSIDERATIONS FOR DEVELOPING WOOD PELLETS **68**

LIST OF FIGURES

FIGURE 1. BREAKOUT OF ELECTRIC AND NON-ELECTRIC FUEL USE TODAY 7
FIGURE 2. PEI ELECTRIC AND NON-ELECTRIC ENERGY USE TODAY 7
FIGURE 3. 2014 PEI GREENHOUSE GAS EMISSIONS BY SECTOR 8
FIGURE 4. 2014 PEI ELECTRIC ENERGY MIX 8
FIGURE 5. 2013 ENERGY USE BY FUEL TYPE 11
FIGURE 6. SAMPLE NON-ENERGY BENEFITS 15
FIGURE 7. PRIMARY RESIDENTIAL HEATING USE 18
FIGURE 8. FORECASTED ELECTRIC ENERGY CONSUMPTION IN PEI 18
FIGURE 9. COSTS OF UTILITY SCALE RENEWABLE RESOURCES IN PEI 28
FIGURE 10. ILLUSTRATIVE DEMONSTRATION OF FORECASTED WIND INTEGRATION CHALLENGES 28
FIGURE 11. PROJECTED LEVELIZED COST OF ENERGY FOR IN-STREAM TIDAL 31
FIGURE 12. PELLET HEATING CASE STUDY 45
FIGURE 13. NEW PELLET COGENERATION TECHNOLOGY 46
FIGURE 14. PUBLIC FAST CHARGING INFRASTRUCTURE EXAMPLES 50
FIGURE 15. EV ADOPTION AND INCENTIVES 51
FIGURE 16. COMPARISON OF OPTIONS FOR REDUCING SOCIETAL AUTOMOBILE COSTS 59
FIGURE 17. EXAMPLES OF REWARD PROGRAMS 60

LIST OF TABLES

Table 1. Comparison of PEI Peak Load to Existing Available Resources 10
Table 2. Comparison of Current Costs Related to Wood and Oil Heating and Fuels in PEI 40
Table 3. Predominant Means of Transport in PEI and Canada (2006) 48
Table 4. Overview of Sustainable Transport Policies 49
Table 5. Potential Diesel Displacement from Locally Produced Biogas 55
Table 6. Potential Diesel Displacement from CNG Trucks 56
Table 7. Current Cost of Residential Heating in PEI 63

PRINCE EDWARD ISLAND: WHERE WE ARE, AND WHERE WE SHOULD BE

Energy is an essential component of our everyday activities. From heat, lighting, transportation, manufacturing, and business, we are dependent on energy to go about our lives and run our businesses. However, Prince Edward Island is heavily dependent on imported fossil-fuel-based energy. Using this energy results in negative consequences on the health of our air, soil and water, contributes to climate change, and means energy-related dollars leave the province rather than benefitting Islanders.

Reducing energy use and incorporating cleaner and locally produced energy sources while stabilizing energy prices is a key issue facing provinces in Canada today. And it is important for Prince Edward Island to play our part in doing so. It is important that our province implement energy policies that focus on sustainability, including approaches to pursue energy efficiency and conservation, renewable energy alternatives and economic support for the province. We are not the only ones saying so:

- The Province's Standing Committee on Infrastructure and Energy's May 10, 2016 report to the Provincial Legislature recommended a goal of 100% renewables in all sectors by 2050.[1]
- The Maritime Sustainable Energy Transition Charlottetown Initiative recommended the three Maritime provinces phase out coal-fired electricity by 2030.[2]
- Prince Edward Island has adopted federal reduction targets equal to or greater than 30% below 2005 levels by 2030.
- Globally, Canada has supported the Paris COP21 goals of limiting rising average temperatures to within 1.5°C of pre-industrial levels (with 2°C a stretch target).

How will we do this?

While our small size presents certain challenges and constraints on what we can do, it also creates opportunities. Our size, along with our engaged population, makes the Island a fantastic place to test cutting-edge, innovative ideas and try new things. We're small, nimble, and flexible. And we can use that to our advantage. In a time when other nations and provinces are committing to cutting greenhouse gas (GHG) emissions and developing plans to mitigate the effects of climate change, and when new technologies and energy management approaches are being applied, opportunities are beginning to emerge.

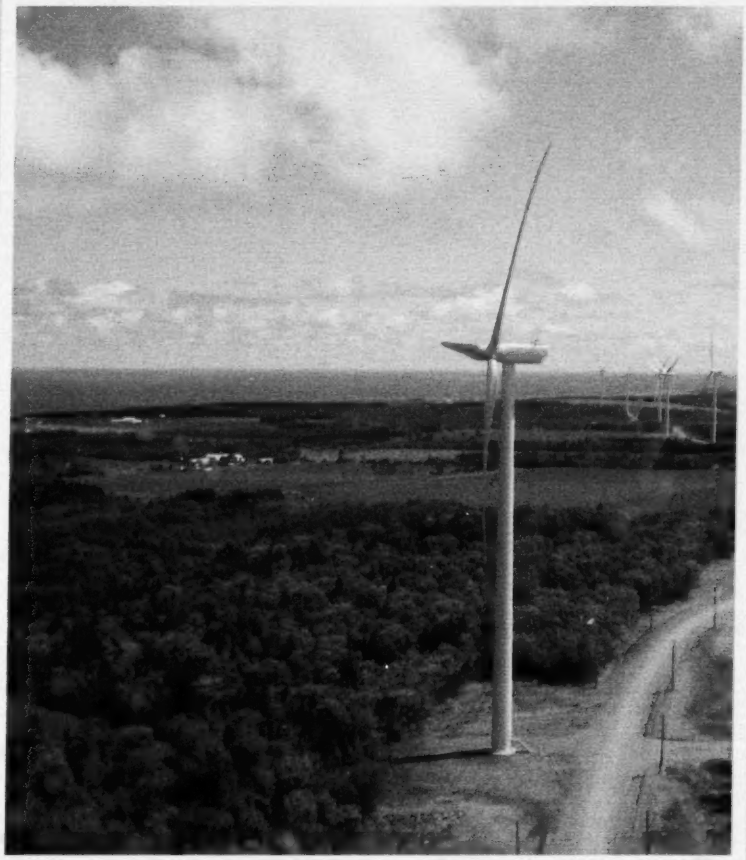
[1] http://www.assembly.pe.ca/sittings/2016spring/reports/21_1_2016-10-05-report.pdf

[2] https://www.ecologyaction.ca/charlottetowninitiative

But what about our economy?

Making positive choices regarding our energy supply is often framed as a choice between our environment and our economy. We hear that if we make "green" decisions, our economy will suffer. But that has been shown to be false, as can be seen in the success of places that have embarked upon a greener economy. The changes to our energy systems resulting from this future will generate economic opportunities that no country or province should ignore. For example, because our province, through the Government, now has the option to own all new on-Island electricity generation, we can all benefit from development of future development of sustainable sources of power, either by reducing what we need to import or by exporting any extra we generate. And we need to be in a position to leverage these opportunities.

A sustainable energy system is one that can renew and maintain itself. A sustainable energy strategy is one that, at its conclusion (or when the next one is developed), leaves the Island with a better future than when it started. But more than this, it's one in which we have a say in our energy future. Whether generating our own clean energy, reducing our energy imports by reducing what we use, increasing our energy exports for our economic benefit, or developing and maintaining strong, mutually beneficial partnerships to receive the energy we need, the best energy future we can have is one in which we play an active role in defining our future.



So that is what this strategy is designed to do. To give us the tools and direction to map out our own future, one in which we determine the right path forward and how to get there. One in which we're a leader in Canada, and even around the world, on the path to sustainability. One in which we contribute our share towards the ambitious Paris climate-change goals and the New England Governors' and Eastern Canada Premiers carbon reduction goals. One in which other places look to us for guidance and as an example. We are already a national and world leader in the area of wind energy production: ***the question is, how else can we lead?***

THE 2016 PROVINCIAL ENERGY STRATEGY

The intent of the 2016 Provincial Energy Strategy is to plan a stronger, more sustainable, and resilient Island. To do this, the Strategy includes strategic, overarching objectives. We also determined the overall direction that we believe the future holds: sustainability and renewability. In developing the Strategy, we kept this in mind while also making sure we based its development on sound evidence and solid data. We presented the background paper to subject-matter experts to ensure we were using the best information available, and we put it on a public website to encourage additional comments from Islanders.

STAKEHOLDER AND PUBLIC INPUT

We recognize the importance of engaging with First Nations through the Mi'kmaq Confederacy of Prince Edward Island. We have done so in the development of this draft strategy and will continue to do so as we propose implementation of action items that may impact asserted or established Aboriginal and treaty rights.

We also listened to all Islanders who engaged with us, and we will continue to do so. We believe this Strategy should reflect the input of the people who live here and the organizations that function here. For this reason, stakeholder consultations played a significant role in the development of this document. Prior to developing the initial draft of the Strategy, we solicited input from a variety of stakeholders, including the public sector, the private sector, and local subject-matter experts. We held targeted consultations with these groups and outreach sessions at various venues around the province. We also requested feedback online and kept Islanders who registered on our website informed of the progress we were making. We then used the input we received to help develop the first draft of the Strategy.

Once we developed the initial draft, we then worked to get additional feedback and input. We provided the draft Strategy online, requesting further input, and we held public consultations in Elmsdale, Summerside, Charlottetown, and Montague. During these sessions, we heard from the public that they wanted an opportunity to comment on the next draft of the Strategy. We listened, and we scheduled an additional, interactive session for after the release of the revised draft. This session was held on June 29th from 7:00-10:00pm at the PEI Farm Centre, during which we received additional input. We also extended the timeframe for the public to submit feedback online until July 15th. This Strategy is the Island's Strategy, one that is intended to benefit all of us.

TIMEFRAME

The Strategy considers a ten-year timeframe in terms of the goals and action items it addresses. However, in order to know what actions we should take over this time, we need to look further out; we don't want to ignore opportunities and actions that need to be taken in a five-to-ten-year timeframe in order to have positive benefits in year eleven or twelve. So while we focus on actions for the medium term, we recognize that there are longer-term implications of the actions we choose to take now.

GUIDING PRINCIPLES

To ensure the Strategy meets its original intentions, it has been developed with the following three guiding principles:

1. *LOWERING GREENHOUSE GAS EMISSIONS*
   Knowing the goals of our country and our province, it was important to generate a Strategy that would align us with this direction.

2. *ACTIONS AND DECISIONS SHOULD BE COST-EFFECTIVE*
   While we need a Provincial Energy Strategy that takes a strategic, appropriate direction, we must consider our existing and future economic conditions. This Strategy has therefore been developed taking into account costs of various options, and favours those that lead to lower overall costs in the long term.

3. *LOCAL ECONOMIC OPPORTUNITIES*

   Part of lowering GHGs and pursuing cost-effective options is focusing on local capacity and development opportunities. If we're generating a portion of our own energy needs, and if we're employing local people, companies and resources, then we are improving our economic situation. If we're reducing the energy we need to import, our money stays here, on the Island. For these reasons, local capacity and development were considered in the creation of the Strategy.

GOALS

Today's world is changing quickly, with technological advances and climate change considerations being built into so much of what we do. Electric cars are quickly becoming cost-effective, distributed generation has become a reality that is affecting the operations of many utilities, and cutting-edge renewable energy technologies are being announced with increasing frequency. Because of this, we can't possibly know all the new advancements and changes to come in the next 5-10 years. This Strategy must, therefore, take into account that we don't know exactly what the future may bring.

The Provincial Energy Strategy should, therefore, in addition to laying out actions to take in the short term, be able to provide guidance and allow flexibility when future decisions need to be made. For this reason, it also outlines overall goals the Strategy is intended to meet. This way, when future changes lead to new directions and opportunities to be taken, the overall direction of the Province will still be identified.

In light of the guidance from the principles outlined above, the goals we are seeking to meet through the implementation of this Strategy are:

1. *RELIABILITY*
   Our energy systems must provide reliable service that meets our needs now and into the future.

2. *INFLUENCE OVER OUR FUTURE*
   Our choices should enhance our ability to have autonomy over our future. By making these decisions, we will have greater control over the prices we pay for energy and reduce the likelihood we will be subject to market influences beyond our control.

3. *LEADERSHIP*
   All else being equal, we consider decisions that demonstrate our ability to be a leader within Canada and globally, such as we are already doing with wind, to be more attractive than ones that don't.

4. *CAPITALIZE ON OUR ABILITY TO BE INNOVATIVE AND FLEXIBLE*
   While our small size can sometimes be challenging, it also provides unique opportunities. Time and again, we have heard from people that they want us to leverage our size to try new things. We can be a testing ground for new technologies and processes, or for implementation scenarios. With expected changes and upcoming federal funding opportunities, we can test new innovations and have profound impacts without the level of investment required in other regions. We shouldn't let a fear of failure stop us from trying things out, and the ones that succeed can provide opportunities to export our knowledge and capabilities elsewhere. We already have resources to help us do so. The Wind Energy Institute of Canada (WEICan) advances the development of wind energy *across Canada*. The University of Prince Edward Island's School of Sustainable Design Engineering offers a specialization option in Sustainable Energy, and Holland College offers an Energy Systems Engineering Technology program focused on ensuring sustainability in energy systems. We can leverage these resources through partnerships, research projects, and by providing opportunities for our youth to apply their skills here, in our own province, rather than having to go elsewhere after they graduate.

5. *CONSIDER OUR CONTEXT*
   Like all provinces, Prince Edward Island has unique elements that must be considered within the decisions we make. We need to consider options that consider this context. Considerations like our island status, aging building stock and rural population can impact the options that make sense for us and we must take these into account when determining actions.

6. *ALIGN OUR DIRECTION WITH FEDERAL POLICIES*

   While new directions in federal policy were unknown at the time this Strategy was developed, the decisions we make today should align with expected directions. We don't know the future, but we know there is a commitment to take action on climate change, and we need the Island to be in position to take advantage of funding and opportunities that will become known in the near-term.

ACTIONS

This Strategy contains overarching principles and goals that will help us to ensure internal consistency and alignment with decisions that we make now and in the future. However, we also need to determine a clear path forward; one that will help us achieve the future we envision. Therefore, it also includes specific action items that we will take to help us achieve our desired outcomes. These action items are listed in each section. Some are quantified and others are directional, but all are designed to start us down the path to greater energy sustainability.

SECTORS

The Provincial Energy Strategy addresses four key areas in which we need to take action to determine our energy future:

- ***Energy Efficiency and Conservation***
- ***Power Generation and Management***
- ***Biomass and Heating***
- ***Transportation***

These sectors, while critical, are not all-inclusive. They are also not independent; rather, they intersect, overlap, and intertwine. For example, energy efficiency encompasses heating options. Distributed generation means that individuals and organizations generate their own energy while saving energy from utilities' and suppliers' perspectives, and transportation is beginning to use electricity and even waste to run. We live in an increasingly complex world. So while this Strategy addresses these sectors independently, it is meant to be taken within an overall context; one section will not work or have the benefits it intends without proper consideration of the others.

There are also areas that cannot be categorized as primarily involving one of the sectors listed above for example, in the areas of Government policy and planning initiatives. For this reason, the Strategy also contains a section of ***Additional Considerations***.

WHERE WE ARE NOW

Before discussing our future, it is important for us to know where we are today. Here, we outline some of the strengths and opportunities that the Island faces today. These considerations help to inform the choices we need to make going forward. Because the Island needs and deserves a sustainable energy future, we must look at the impacts of our overall energy use. Figure 1 therefore shows our overall energy use and breakouts by sector, and Figure 2 shows how much of our total energy requirements comes from our electricity system compared to other sources. While electricity is a critical component of our energy supply, it supplies only 21% of our overall energy needs. So an integrated Strategy must look at all our other sources of energy as well.

Figure 1. Breakout of Electric and Non-Electric Fuel Use Today

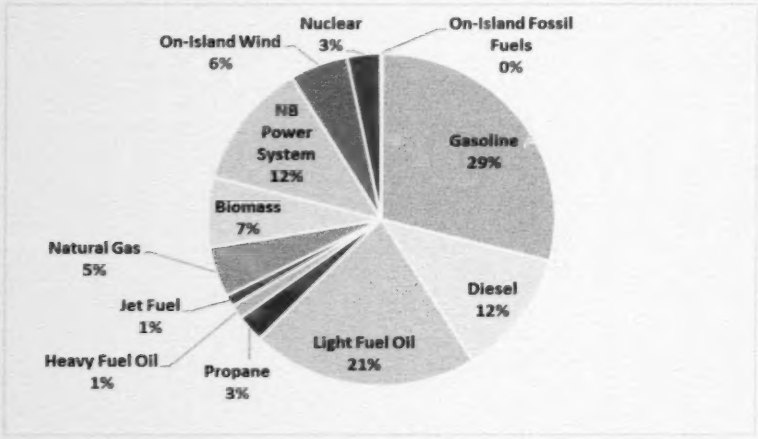
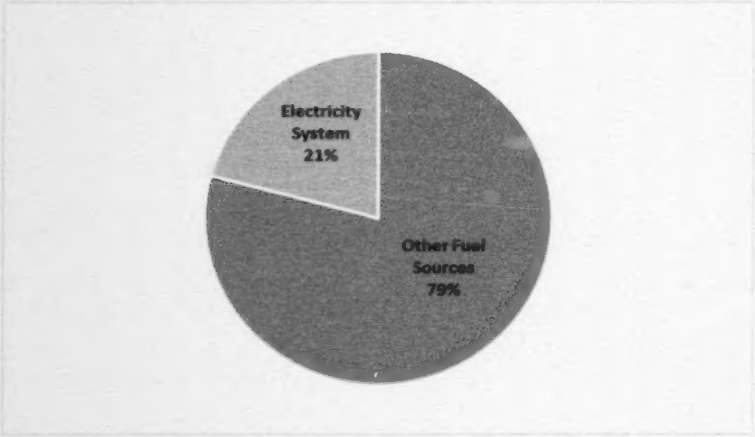


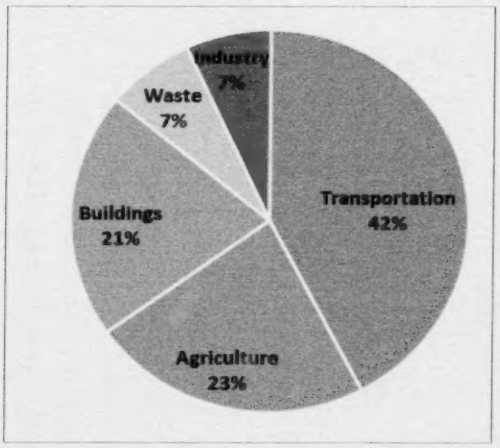
Figure 2. PEI Electric and Non-Electric Energy Use Today



We are entering a period in which we must address climate change and make our entire energy system more sustainable. In order to do so, however, we must understand where we are today. Figure 3 therefore shows our greenhouse gas emissions by sector in 2013, the most recent year for which data is available. Because we are a small economy, our emissions can change year-over-year based on external factors beyond our control. How to calculate and address improvements and changes will be an important consideration as our province embarks on climate-change mitigation and adaptation strategies. Energy is an important consideration in those pieces, however, and the two strategies are intended to align.

Because the way in which we generate, distribute, and use energy is different for our electric and non-electric sources of fuel, the following sections discuss each source of fuel separately.

Figure 3. 2014 PEI Greenhouse Gas Emissions by Sector

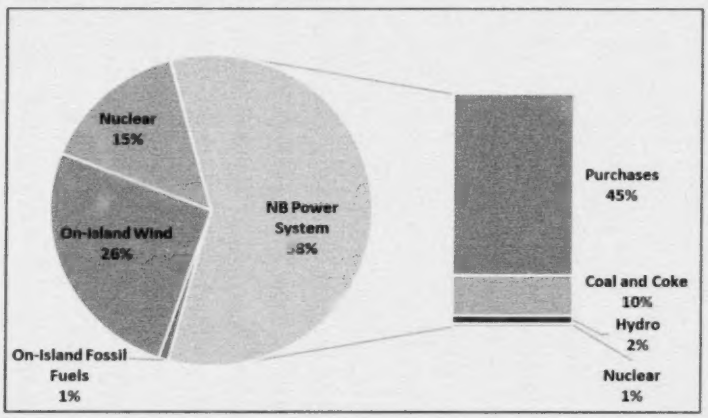


PRINCE EDWARD ISLAND'S ELECTRICITY SYSTEM

Figure 4 shows Prince Edward Island's electricity mix by resource type. Imports from New Brunswick Power currently represent almost 60% of our total electricity mix, since New Brunswick Power is generally able to offer electricity at a lower cost than our utilities can generate given their available fossil fuel resources. Because of this heavy reliance, Figure 4 also shows New Brunswick Power's general supply mix. In the future, there may be potential for us to supplement these imports with renewable energy from Newfoundland (with the construction of the Maritime Link) and Quebec.

This high percentage of imports shows the importance that New Brunswick plays in our electricity supply. Under our principles and goals, we should seek opportunities to reduce our dependence on these imports. However, at the same time, we must recognize New Brunswick as a partner in our energy present and our energy future.

Figure 4. 2014 PEI Electric Energy Mix[3]



[3] Calculated from various Maritime Electric, Summerside Electric, and New Brunswick Power generation data

In terms of our local influence and capacity, on-Island wind generation currently provides approximately one-quarter of our total electricity requirements. Considering the amount of wind on our system is second in the world only to Denmark, this is an impressive accomplishment. The vast majority of this supply also stays on the Island. Other than the output of one wind project that was developed for export purposes, the only time it is exported is when our local needs are lower than the supply of wind, in which case the electricity is delivered to New Brunswick.

Electrical energy use is the amount of energy we require or are expected to require over the course of a year. Peak demand, however, is how much electricity is needed to supply the maximum amount we are expected to need at any particular moment during the year when our consumption is highest. A significant portion of our capacity (resources that have been developed to ensure our electricity supply is reliable) is provided by on-Island generation, including 159 MW of on-Island thermal generation and 28 MW of wind generation. Although we currently have 204 MW of wind-generating capacity in the province, it is an intermittent resource (the full amount is not always available when we need it). As a result, we cannot assume the full amount will be there when it is required, electric reliability standards require us to assume only 14% of installed wind capacity will be available during peak periods. This requirement ensures that we maintain access to enough back-up generation that can be started on demand if required.

Our on-Island generation is supplemented by electricity that is delivered by the cables that connect us to the New Brunswick Power system. The amount of electricity that can be supplied by these cables at any one time (plus the need to be able to continue to supply our needs if one of them is out of service), and New Brunswick's own internal constraints, limit the amount of capacity that we can purchase from New Brunswick. The addition of two new submarine cables will increase this capacity, but a constraint still exists.

The Charlottetown Thermal Generating Station (CTGS) is expected to be fully retired in 2021 (see Table 1 for an overview of our electricity system as it exists today and as it is forecast out to the future if we make no significant changes). While our utilities are not forecasting the need for future new capacity at this time, it is best if we are prepared should the need arise. Any proposed replacement electricity source will be reviewed before the Island Regulatory and Appeals Commission, and Government will participate in a review of any need for additional backup capacity as well as the assessment of alternatives for meeting our future capacity requirements. Deferring future capacity requirements with additional energy efficiency or energy storage are considered further in this Strategy.

Table 1. Comparison of PEI Peak Load to Existing Available Resources[4]

Load Requirements	2016	2017	2018	2019	2020	2021	2022
Forecast Peak Load	264	266	271	276	281	286	294
Interruptible Load	-15	-15	-15	-15	-15	-15	-15
15% Planning Reserve	37	38	38	39	40	41	42
Total Load Requirements	**286**	**289**	**294**	**300**	**306**	**312**	**321**
Available Capacity							
Charlottetown Generating Station	55	55	55	0	0	0	0
Borden Plant	40	40	40	40	40	40	40
Combustion Turbine 3	49	49	49	49	49	49	49
Summerside Thermal	15	15	15	15	15	15	15
Total On-Island Thermal	**159**	**159**	**159**	**104**	**104**	**104**	**104**
Point Lepreau	29	29	29	29	29	29	29
Maximum Off-Island Purchases	170	170	170	170	170	170	170
Effective Capacity of On-Island Wind	28	28	28	28	28	28	28
Total Available Capacity (sum of Total On-Island Thermal and other sources)	**396**	**396**	**396**	**341**	**341**	**341**	**341**
Capacity Surplus/Deficit	**110**	**107**	**102**	**41**	**35**	**29**	**20**

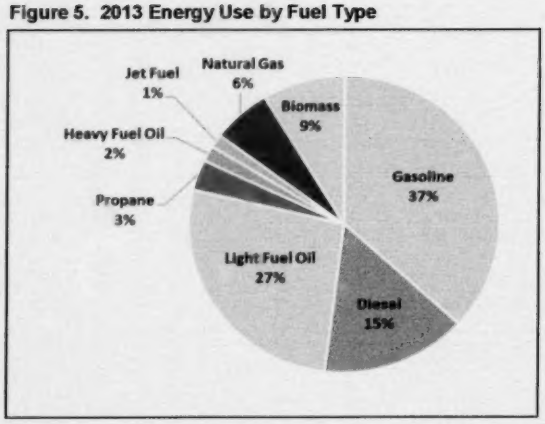
NON-ELECTRIC ENERGY

Prince Edward Island's energy needs are greater than those of our electricity system alone, and they must be considered in any comprehensive energy strategy.

Many of us are concerned about electricity rates and our use of electricity. However, as Figure 1 earlier in the Strategy shows, 78% of our fuel-related needs are for uses other than electricity. Figure 5 shows the breakout of these non-electric sources, of which the vast majority are imported. While we do not expect to be self-sufficient for all our energy needs in the next decade or so, an over-reliance on imports is of concern, because pricing of these fuel sources is generally not under our control. While oil and gasoline prices reached significant lows in 2015 and are expected to remain low in the near term, these low prices are not expected to last.

[4] Maritime Electric and Summerside Electric load forecast data

Figure 5. 2013 Energy Use by Fuel Type



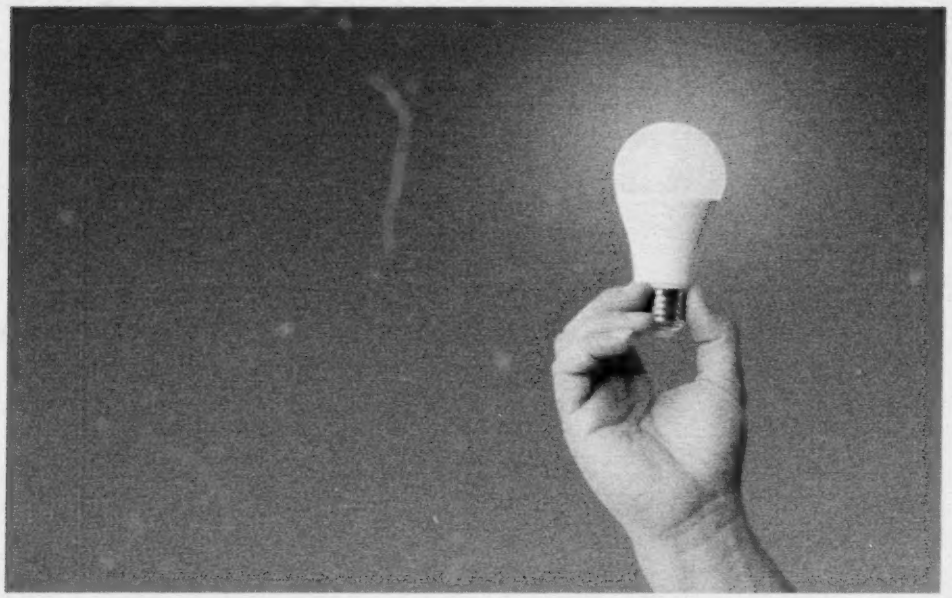
In addition, the vast majority of our non-electric fuels are non-renewable and high contributors to emissions. In fact, 86% of our emissions come from using fuel oil, gasoline and diesel to heat our buildings and power our vehicles. This means there is great potential to reduce our use of these fuels. Even small changes in our use can have a big impact on our province's energy future.

Natural gas, while it burns much more cleanly than other fossil fuels, makes up only 7% of our non-electric fuel use (and is currently primarily used for industry). Expanding our access to natural gas is one option going forward, but it does not address some of the key considerations of this Strategy. It is not sustainable and it must be imported. This is an important point. We have made great strides in making our electricity system more renewable and sustainable in the past number of years, but we have not done this to the same extent for our use of non-electric fuels. The Office of Energy Efficiency (now Efficiency PEI) has assisted Islanders in reducing the amount of fuel they use over the past years; however, we have not made our overall use of non-electricity sources more renewable or sustainable.

Under the principles and goals of this Strategy, we will seek opportunities to reduce our dependence on these imported and fossil-fuel-based energy sources.

WHAT THIS MEANS

In both our electric and non-electric fuel use, there is great potential to reduce our emissions and our impact. It is an exciting time for us: federally and globally leaders and individuals are poised to change the way we consume and use energy. With so much potential and opportunities for us in terms of the energy we use, Prince Edward Island has a great opportunity to contribute to these changes. While we may not use a significant amount compared to other provinces, we all must do our part.



ENERGY EFFICIENCY AND CONSERVATION

The cheapest energy is the energy we don't use. While producing sustainable and renewable energy is a critical part of our future, it is important that we first reduce the amount we are required to produce – this is the cleanest, cheapest form of energy for our province. In other words, we can reduce our costs by reducing the amount of energy we require in the first place.

Energy efficiency and energy conservation are complementary ideas, although both involve the reduction of energy use. Conceptually, we can think of ***conservation as reducing energy waste*** and ***efficiency as providing comparable or improved service using a reduced amount of energy***. An energy strategy needs to embrace both paths, reducing the energy we waste and ensuring we are installing more efficient equipment, to maximize energy savings and reduce our need for energy.

Energy conservation can be achieved through behavioural changes, which is an important inclusion in the activities we do. Maritime Electric has already developed an education and outreach plan approved by the Island Regulatory and Appeals Commission, and this is a good first step. However, energy conservation can also be accomplished through the installation of equipment and materials. For example, increasing the insulation in a building reduces the amount of energy that is lost through that building's shell. Installing programmable thermostats allows for temperature to be reduced when buildings are unoccupied, thereby reducing energy waste.

Energy efficiency involves equipment that consumes less energy to carry out the same function. Replacing older appliances with new highly efficient ones or replacing incandescent light bulbs with LEDs are two examples.

For Prince Edward Island to meet its future energy needs and GHG reduction targets, a broad range of efficiency and conservation measures (referred to as "efficiency" for the remainder of this document) will be needed. We have opportunities for efficiency programs that will assist Islanders with improving the heating and cooling performance of their homes and buildings, and with installing more efficient lighting and appliances. Replacing equipment and enhancing performance of our buildings is one thing, but we also need to ensure they are efficient from the start to achieve maximum benefit. For this reason, we also need to examine changes to codes and standards to ensure that new buildings are more energy efficient when they are built or renovated, and that the least efficient appliances are removed from the market.

While the above explanations of energy efficiency and conservation apply to all forms of fuel, including electricity, oil, gasoline, and others, there is an additional component that must be considered for electricity specifically. We have to consider two major components of electricity use: energy use and peak demand. The Island may face capacity constraints in the near term, meaning that our demand for electricity is expected to approach the limit of what our system can supply. In Prince Edward Island, peak demand usually happens in the winter (December, January or February) between 5 and 7pm. This is when individuals are at home while businesses are still open, all of which require lights and heat, and the operation of other electrical loads. ***In order to align demand and our ability to meet it, then, we also need to examine ways to reduce our demand, or spread it out so we are not all using electricity at the same time***.

Energy efficiency and conservation can also be pursued in the transportation sector. However, this section focuses on energy efficiency for buildings and equipment; options for reducing energy use in transportation are included in the Transportation section of this Strategy.

APPROACH TO ENERGY EFFICIENCY AND CONSERVATION

Energy efficiency is generally the lowest-cost energy option for utilities or governments.[5] Even when we add the costs that participants pay to incentives or efforts by energy efficiency organizations, the cost for many activities is well below the supply of electricity. For example, at a cost of $0.03 to $0.05 per kWh for the utility (not including low-income programs), efficiency costs less per kWh than buying electricity. Costs of offering non-electric energy efficiency programs, when compared to a conservative price of $0.68 per liter of heating oil, are significantly less. Energy efficiency is also more flexible and scalable than building new generation, so the amount of energy efficiency achieved can be increased or decreased over time according to our needs. For example, if we were to build a new generator that could supply 50 MW of electricity, we would pay for that generator and its 50 MW even if we only ended up needing 40 MW for the first half of its life. Or we could miscalculate and actually need 52 MW. But energy efficiency is different; if it is only beneficial to achieve 2 MW of demand savings each year for ten years, and then 3 MW after that, we can do that. Or, if we end up needing more, we can increase our level of activity – only paying for the amount that is less expensive than generation. This low cost and flexibility makes energy efficiency highly attractive and positions it as an important contributor to meeting the province's future energy needs, giving us flexibility and reducing our dependence on imports.

In addition to the benefits to Islanders in the form of cost savings, pursuing high levels of energy efficiency advances each one of the Strategy's guiding principles and goals. By helping Islanders use less energy, less fuel needs to be consumed to produce that energy, which reduces GHG emissions. Reducing energy consumption also has the benefit of reducing our reliance on imported fuels, which advances the goal of energy security. And energy efficiency is a labour-intensive industry; it requires local people, on the ground, to conduct energy audits, install equipment, and sell services. According to one 2014 study, if Prince Edward Island pursued annual electric and non-electric (fossil-fuel-based) energy savings of 1.75% of existing consumption, there could be up to 312 jobs created. So there is a local employment gain, which has positive impacts for the local economy that imported fuels cannot match.

The Provincial Energy Strategy recognizes that energy use needs to be addressed on a societal level. Since the goals of the Strategy are societal in nature, the cost-effectiveness framework governing energy efficiency programs should take a similar societal viewpoint. This means that ***all the benefits (energy/demand and non-energy benefits) that are a result of energy efficiency should be considered when determining which specific actions should be taken*** (see Figure 6 for examples). Energy efficiency has many near- and long-term benefits. A societal perspective allows planning for the long term and the cost-effectiveness framework should reflect that.

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[5] ACEEE, "New Report Finds Energy Efficiency is America's Cheapest Energy Resource", March 25 2014. http://aceee.org/press/2014/03/new-report-finds-energy-efficiency-a

Figure 6. Sample Non-Energy Benefits

PARTICIPANT	PROGRAM ADMINISTRATOR	SOCIETY
•Water savings •Increased comfort •Noise reduction •Equipment: reduced operations and maintenance costs •Increased property value •Improved air quality and safety •Lower operating costs •Increased productivity •Low-income specific benefits	•Reduced arrearages and bad debt (especially low-income) •Reduced service costs (especially low-income) •Supply and demand planning risk mitigation	•GHG reductions •Reductions in other emissions (NO_x, SO_2, PM) •Demand reduction-induced price effect (DRIPE) •Economic impacts (GDP, jobs, tax revenues) •Energy security

Energy efficiency is also an area in which Prince Edward Island can be a leader. Because the amount of activity we undertake is directly proportional to how much we consume, it is also proportional to the percentage of reduction we achieve. Leading jurisdictions often undertake efforts of 1.5% or higher of their total electrical or natural gas load, plus activities for non-electric energy reduction. At our current levels, Prince Edward Island can meet these targets to reduce our emissions and develop local capacity in a cost-effective manner. For these reasons, we are setting an eventual target of 2.0% of electric load, or just under 30 GWh per year if our load stayed the same each year. In order to develop the knowledge and capacity to achieve these goals, however, we need to build up to this. Starting at 0.4% of load in 2017, and achieving an additional 0.4% of load each year until we hit 2.0% in 2020 is achievable. A corresponding target for non-electric fuels is to ramp up to 2.0% of fuel oil use annually by 2020. Efficiency PEI's current suite of programs are currently weighted towards household heating oil demand, achieving savings of approximately 1.1% of annual consumption, indicating that 2.0% annual reduction, with its additional benefits for Islanders, is achievable.

What do we mean by 2% per year?

The recommended target of 2% of electricity load per year is a moving target. This means that 2% of each year's expected electricity requirements will be planned to be met through energy efficiency. For example, in late 2015 or early 2016, the utilities would provide their forecasts for 2017, and those forecasts would be used to develop the 2017 energy efficiency target, which would be 2% of the total load requirements. The same process would happen year after year (or on a multi-year basis if multi-year energy efficiency plans are developed).

The bill savings for Islanders would be substantial with this level of efficiency. Based on current electric rates, a 2% reduction in residential and general service 2016 forecasted consumption would result in bill savings of $1,700,000 and $1,515,000, respectively. A 2% reduction in non-electric fuel would result in bill savings of $1,790,000.[6] And those are only in 2016: those savings reoccur each year, with new savings added on from new participants.

Action Items

- Achieve electricity savings 2.0% of electricity consumption each year by 2020.
- Achieve energy savings of 2.0% per year of non-electric, non-renewable fuels.
- Mandate an energy efficiency cost-effectiveness screening framework that considers a societal perspective including non-energy benefits.

ADMINISTRATION OF ENERGY EFFICIENCY

Islanders use a variety of fuels to meet their daily needs. Electricity is common to everyone, but many buildings in our province rely on non-electric fuels (oil, propane and/or wood) to provide space heating and other services. Therefore, an energy efficiency policy should assist Islanders in reducing their energy consumption regardless of the fuel they use, as long as it is cost-effective. However, our current system can make it difficult for residents and businesses to access relevant programs. Efficiency PEI is responsible for non-electric energy efficiency, Maritime Electric is responsible for electricity energy efficiency for its customers, and Summerside Electric is not currently required to conduct energy efficiency activities, although it is involved in some efforts.

However, this is not efficient. Because of the mix of fuels, there are many opportunities to adopt complementary efforts between energy efficiency activities. Maximizing energy savings (and reducing project costs) occurs if all sources of energy use are accounted for when participants are implementing energy efficiency projects; different pieces of equipment in a building act in concert with the others and a change in one can have effects on others. In addition, a societal perspective suggests that all Islanders should have access to some form of energy efficiency services. Good program design and marketing suggests that it should be easy for residents and businesses to find the services that can assist them, or they won't take advantage of these opportunities.

There are a few ways to structure the delivery of energy efficiency on the Island. These include programs being offered by government, existing utilities, dedicated efficiency utilities or combinations thereof. Often, the type of energy efficiency administrator in a jurisdiction is a product of the history of how its programs were established and have evolved. As we are about to embark on a renewed focus for energy efficiency with a broad multi-fuels mandate, we have an opportunity to select an energy efficiency administrator that best aligns with our policy goals.

[6] This calculation assumes all non-electric fuel is heating oil, although some may be propane and wood.

Currently, the province's Electric Power Act states that electric energy efficiency should be conducted by a utility (Maritime Electric) and regulated by IRAC. This is a useful model for providing independent oversight of energy efficiency that ensures investments are made appropriately and prudently. However, Summerside residents or non-electric customers do not have the same benefits.

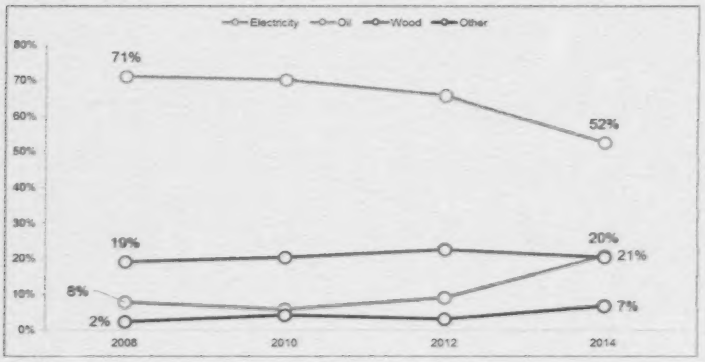
A separate, dedicated energy efficiency utility, focused on assisting Islanders to reduce their energy use, has advantages over other models. It allows for a single entity to be responsible for all energy efficiency programs regardless of whether they are designed for electric or non-electric fuel savings. A single entity can develop consistent branding, outreach and marketing to ensure that Islanders know where to turn when they need information on improving their energy use. By having a separate energy efficiency utility there also is no real or perceived conflict between selling a particular fuel and also helping Islanders consume less of it. Finally, creating a single utility with a multi-fuels mandate allows for all Islanders to participate in programs regardless of the utility jurisdiction they live in. While different utilities offering different programs or incentives is not an insurmountable problem, it is not efficient from a customer standpoint. A single entity, focused on efficiency, with a multi-fuels whole-province mandate, is a more efficient way to go. It can assist with both heating and electricity savings, and it could also include transportation energy efficiency. Funding for electricity-based programs can still be provided from the utilities (each contributing a share), and funding for non-electric programs can be provided via a surcharge on other fuels, which are also regulated by IRAC. A widened mandate could also include various other energy-related measures, such as smart grid technologies.

Action Item
• Set up an independent energy efficiency (or Energy Smart) utility with a mandate to pursue efficiency for all fuels.

RESIDENTIAL

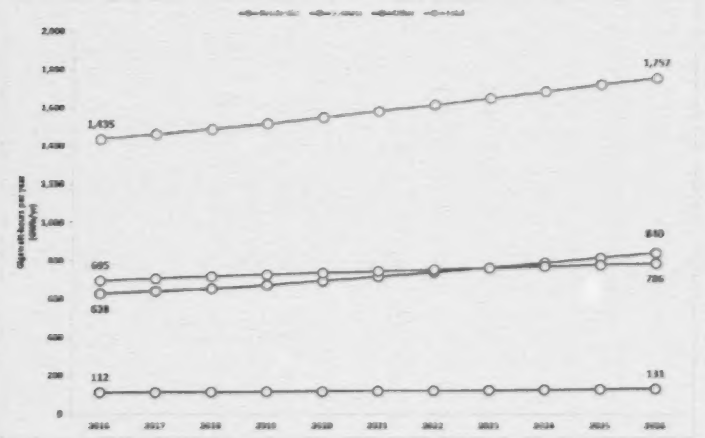
Due in large part to the advent and improvements in heat pumps over the past decade, electric heating is on the rise in the Maritimes generally, and Prince Edward Island specifically, as Figure 7 shows. However, approximately 50% of Islanders still have oil as their primary heating systems (with over 70% still using oil in some way), making it a significant part of our energy use.

Figure 7. Primary Residential Heating Use[7]



Partially because of this switch to electric heat, and partially because of other uses of electricity, including the appliances that are part of modern life, electricity use in the residential sector is becoming an even more significant part of our total energy use. For electricity specifically, the electric demand forecast shown in Figure 8 shows that residential consumption in 2020 will account for roughly 50% of total electric use.

Figure 8. Forecasted Electric Energy Consumption in PEI[8]



This means that residential energy use, both electric and non-electric, is a critical area of opportunity for energy efficiency. However, it is important to note that, just as it increases efficiency to offer programs for all fuels rather than having to go to different organizations for assistance based on the type of appliance or who a customer's supplier is, it also increases efficiency to provide programs that offer a comprehensive set of options for residential customers. We should not offer programs just for lighting now, and then appliances later, and

[7] Based on data from the *Prince Edward Island Home Heating Survey 2014 Final Report*

[8] Maritime Electric's Residential, Business, and Other percentages have been applied to Summerside Electric's total forecast. The "Other" category includes street lighting/unmetered, utility electricity use, and line losses. Potential energy efficiency activities are not included in the forecast.

insulation even later. Customers should be able to access programs when they need them, and when they are building or renovating their homes. ***For this reason, we need to offer programs that allow Islanders to achieve all cost-effective energy savings, rather than simply assisting them only with certain products or technologies.***

For example, comprehensive energy retrofits touch on every aspect of energy performance in a house. This includes the performance of the building shell itself, along with a home's mechanical systems. Deep energy efficiency retrofits increase a building's insulation and reduce air leaks, which has a dramatic effect on the energy required to keep a home at a comfortable temperature during both the summer and winter. This is important particularly in Prince Edward Island, since our building stock is old and much of it is either poorly insulated or not insulated at all. A home with a highly insulated shell loses less heat to the outdoors and therefore requires less additional energy to maintain a comfortable temperature. Reducing the demand for additional heat in the winter also reduces the rise of the peak demand related to electric heating.

COMMON RESIDENTIAL PROGRAMS

- Audit and Weatherization
- Lighting
- Products and Appliances
- Whole House Retrofit
- Low Income
- New Construction
- Heating, Ventilation, and Air Conditioning
- Multi-Unit Residential Buildings
- Behavioural
- Financing

It is only after addressing the building shell that it makes sense to begin substantial improvements to the heating system. "Right-sizing" the heating or cooling equipment based on the new requirements of the home using an energy efficient heating appliance, or reworking the distribution network of pipes or ducts to improve delivery, are common measures. Space heating and water heating are generally the two largest end uses for energy in a home.[9] However, lighting and appliances are significant consumers of energy as well. For a wide range of appliances, such as fridges, freezers, air conditioners, clothes washers and dryers, there are independent rankings such as ENERGY STAR® or CEE that make it easy to identify which models of an appliance are the most energy efficient.

New construction programs encourage new buildings to be designed with energy use in mind. It is easier (and more cost-effective) to build to a high standard the first time rather than retrofitting later. A new construction program with incentives for performing above existing building codes can help decrease a building's energy consumption in a myriad of ways. Incenting for performance above code can result in buildings with more efficient shells and appliances, but also design choices that take advantage of, for example, south-facing exposures for passive solar heating or natural light to reduce the need for artificial light. These adaptations would be hard to implement in a retrofit, but if these considerations are present at the design stage they can be practical and produce energy savings for the lifetime of the building.

[9] http://oee.rncan.gc.ca/publications/statistics/trends11/chapter3.cfm?attr=0

Low-income residents in Prince Edward Island face some of the biggest challenges in reducing their energy use. The cost of energy bills for low income residents can be a substantial part of their monthly expenses (energy poverty can be considered to occur when residents spend more than 8-10% of their income on energy[10]), making it very difficult to be able to invest in the types of programs included in this Strategy. For these reasons, many jurisdictions have specific Low Income programs that address the unique barriers that low income residents face, including providing incentives for the full value of energy-efficient installations in addition to supportive project management. ***By implementing a Low Income program, we will ensure all Islanders will have the opportunity to participate in efficiency programs that will reduce their energy use and make their living spaces more affordable***.

Action Items

- Implement a comprehensive set of energy efficiency programs that enable customers to reduce their energy use in a cost-effective manner. Standard programs include deep energy retrofits for building shells, residential new construction, appliance recycling, and encouraging sales (through rebates) of the most efficient appliances and lighting. These programs must be supplemented with public outreach and education initiatives for all forms of energy in order to succeed.
- Implement a Low Income Residential program for Islanders who could not otherwise afford to participate.

COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL

Since residential energy use accounts for roughly 50% of our electric consumption, the commercial, industrial and institutional sectors account for remainder (less a small amount for street lighting and other similar uses). Commercial and institutional buildings on average have similar end uses as the residential sector. This means that many of the efficiency measures described for the residential market — building shell improvements, HVAC equipment efficiencies, and lighting — apply to this sector as well. ***Similarly, it is more effective and efficient to offer a comprehensive set of programs rather than a limited set of technologies or assistance, as long as the offerings are cost-effective***.

Small businesses make up a large portion of the businesses on the Island, and this customer class faces significant barriers to participating in energy efficiency programs. Small business owners often face real limits on their resources, including both time and capital. Energy efficiency programs aimed at the small business market need to be aware of, and address, the issues that hinder small business participation. Such programs can include additional support such as project management or direct install options.

Energy efficiency measures for the small business market closely mirror those for the residential market. Building shell improvements, mechanical systems improvement (including refrigeration) and lighting measures

[10] Affordable Energy Coalition, "Towards an Energy Poverty Strategy for Nova Scotia", http://www.coastalcommunities.ns.ca/documents/EPSF.pdf; Fraser Institute, "Higher energy prices fuel energy poverty in Canada – especially in Ontario", https://www.fraserinstitute.org/article/higher-energy-prices-fuel-energy-poverty-in-canada-especially-in-ontario.

are the core opportunities. For the commercial and institutional sector, cooling and heating consume a significant portion of the building's total energy use. The measures to address the building shell are similar to those found in the residential sector and small business, namely increased insulation, and weatherproofing to reduce air leakage. The mechanical systems for large buildings tend to be more complex than those of residential buildings and include ventilation systems and mechanical rooms with large heating, ventilation, and air conditioning equipment — boilers, furnaces and chillers. As is the case for the other sectors, "right-sizing" the equipment after shell improvements with high efficiency HVAC equipment is common. There are also many lighting efficiency measures available in the commercial/institutional sector including lighting equipment, controls and lighting space design.

Specific commercial sectors also have options that can meet their needs:

- In commercial kitchens, food refrigeration, efficient exhaust hoods, high efficiency commercial cooking appliances and refrigeration are all available. Open refrigerators and freezers, prevalent in grocery stores (and some convenience stores) can be retrofitted with doors and LED lighting.
- For the agricultural sector, space heating is not as important a concern as in the residential and commercial sectors. Agricultural facilities do, however, have potential lighting efficiency opportunities as well as savings from ventilation fans and motors.
- The industrial sector is different from other sectors, in that the end-uses of energy are incredibly varied compared to homes and commercial/institutional buildings. Energy efficiency programs for this sector therefore often take a custom approach. The industrial sector has less emphasis on building shell improvements as there is often equipment and processes taking place that generate heat. On the other hand, there are often opportunities for more efficient pumps, motors and fans as well as process heating and cooling that may not be present in the other sectors. Working with industrial clients to determine which efficiency measures make sense for their particular situation is important.

COMMON COMMERCIAL/ INDUSTRIAL PROGRAMS	COMMON AGRICULTURAL PROGRAMS
•Small Business •Commercial Lighting •Commercial New Construction •Commercial and Industrial Comprehensive •Commercial and Industrial Custom •Commercial and Industrial Retrocommissioning •Large Commercial and Industrial Programs •Financing	•Refrigerated Warehouses •Dairies •Food Processors •Financing

As time goes on, equipment which was once operating with its optimal settings can drift from its design parameters. Recommissioning an industrial site, which involves looking at the equipment performance and system integration issues, ensures that the equipment in place is operating at its most efficient configuration

and identifies other energy savings opportunities. Recommissioning is not only important in the industrial setting but is used in large commercial/institution spaces as well.

Action Item
• Implement a comprehensive set of energy efficiency programs that enable commercial, institutional, and industrial customers to reduce their energy use in a cost-effective manner. Standard programs include small business programs, encouraging sales of the most efficient appliances and lighting, and custom options for large customers.

GEOTARGETED ENERGY EFFICIENCY

The Island's transmission and distribution grid is an essential component in the delivery of electricity to Islanders. Ongoing investment is required for maintenance and replacement of equipment reaching its end of life. However, there are times when the existing infrastructure in place needs to be upgraded in order to handle load growth. In these cases, ***one option to pursue that might alleviate the need for increased transmission and distribution capacity is geotargeted energy efficiency***.

Geotargeted energy efficiency refers to the idea that aggressively pursuing energy efficiency in a specific area can be an appropriate, cost-effective way to avoid having to upgrade specific parts of the grid in response to load growth. This can take the form of either demand response measures, energy efficiency measures, or both working in tandem to address the load growth. Strategies we can use to increase participation in energy efficiency programs in these areas might involve intensive marketing of existing programs in the relevant areas, increased incentives, or others. Geotargeted energy efficiency won't alleviate the need for investments in the grid, and it won't avoid the need to upgrade the grid to meet load growth in all cases, but it should be considered and evaluated as a potential option when upgrades to transmission and distribution are expected to be required in the future.

Action Items
• Develop a set of guidelines for when Geotargeted Energy Efficiency should be considered when a transmission or distribution grid intervention is required.
• Develop Geotargeted Energy Efficiency protocols as part of the comprehensive set of programs and services offered by the energy efficiency utility.

CODES AND STANDARDS

Codes and standards apply not only to the appliances and equipment used in buildings but also to the buildings themselves. While Prince Edward Island is a small market and therefore not in a position to develop new appliance standards on its own, building code changes are an area in which the Provincial Government can have effective impact. ***The first step is putting the National Building Code and the National Energy Code for Buildings (2015) in place across the entire Island.*** While the National Building Code is enforced in Charlottetown, Summerside and Stratford, builders outside of these areas are not required to follow it. Government's current plan is to table a bill in the fall 2016 sitting. This is key. Adding the National Energy Code for Buildings is an additional important step. During stakeholder consultations, we heard many comments about

the need for the legislature to approve the National Building Code. However, beyond this, new provincial "stretch" building codes can go above and beyond national minimum requirements.

Energy efficiency changes included in a provincial building code would raise the baseline energy performance of all new construction. The Provincial Government could also require code compliance for substantial renovations. ***Requiring higher standards of energy efficiency in the building code has effects that last much longer than many other types of interventions because buildings are usually designed to be used for decades, whereas other energy efficiency measures have shorter life times***. Several other provinces and territories are working with building codes that require higher performance than the national codes. Considered an exceptional goal just some years ago, net-zero energy buildings and Passive House buildings are now being built across Canada at costs only marginally higher than conventional homes. Introducing such technologies on the Island to pave the way for later wholesale adoption of vastly more energy efficient buildings is a good starting point towards more efficient buildings. It would also fit our goal to be an innovation hub and "laboratory" for new technologies.

For example, within Canada, the City of Vancouver has adopted building practices with more stringent requirements than those found in the National Building Code and the National Energy Code for Buildings (2015). The City of Vancouver requires homebuilders to work with Certified Energy Advisors during the design and inspection phases for all new home construction.[11] In addition, by 2020, Vancouver will require that all new homes are carbon neutral and use 50% less energy than homes did in 2007.

The National Research Council (NRC) publishes updated editions of the National Building Code approximately every five years. One practical approach for us to develop and make continuous, incremental improvements to our own, more aggressive building code, would be to mirror the NRC schedule with a one-year lag. This would mean that, five years from now, we would develop a "stretch" building code that is more stringent than the requirements of the future 2020 National Building Code. This would give us time to plan and determine which areas make the most sense for PEI to move ahead with additional requirements or more stringent codes. It also sets the practice of enhancing the stretch code every five years to require greater efficiency, allowing industry to be able to plan for changes in building practises.

In addition to the building code, mandatory building labelling at time of sale can be an effective way to promote efficiency. Building labelling requires that an energy audit be performed and then the building is given a score based on its performance. The building label provides information to potential buyers regarding the energy operating costs of the building (home or otherwise) before they purchase it. This serves to increase the value of energy efficiency upgrades that might otherwise not be reflected in the selling price (a house which is highly efficient will have lower annual energy bills and therefore command a higher price). Another benefit is that new homeowners often renovate before moving in and the building energy label can be a reminder of potential energy efficiency issues. The same sort of arguments apply to the commercial rental space market. A

[11] http://vancouver.ca/home-property-development/energy-efficiency-requirements-and-resources-for-new-homes.aspx

building with lower energy bills can command a higher rent, which encourages building owners to undertake energy efficiency improvements.

While Prince Edward Island is not in a position to drive appliance standards on its own, it can benefit by adopting standards above the minimum efficiency required by the federal Energy Efficiency Act. Canadian appliance standards are routinely harmonized with American standards due to the integrated nature of the North America appliance market. This harmonization has a lag time and the "in-between" period allows for appliances with a lower efficiency to be sold in Canada but not in the United States. If we were to adopt regulations that more closely followed the US standards, or even exceeded them in some cases, then we can move faster towards a more efficient stock of installed appliances that consume less energy.

Action Items

- Implement the National Building Code and National Energy Code for Buildings, province-wide, as soon as possible.
- Develop and adopt a provincial "stretch" building code with energy efficiency levels above that of the National Building Code by 2021, and enhance the code one year after each National Building Code is released.
- Support pilot projects for highly efficient buildings to pave the way for more aggressive building performance standards in the future.
- Implement mandatory building labelling for the residential sector when homes are listed for sale.
- Examine the feasibility of a mandatory commercial/institutional building energy reporting system, or a voluntary one led by Government buildings.
- Monitor appliance standards approved in the United States or in other provinces and consider adopting them on a case-by-case basis.

DEMAND RESPONSE

So far in this section we have been discussing reducing energy use. But energy efficiency and, in particular, demand response, also have an impact on electric demand. While many energy efficiency measures also reduce demand, there are particular strategies that focus on demand savings. For example, an LED lamp draws less power than an equivalent CFL bulb. Since many lights are in use during peak load, the LED bulb helps to reduce the size of the peak. This is useful but cannot help an electric utility manage the grid because it does not have any control when the bulb is on or off. This is where demand response can play a role. Peak demand is currently rising in the province, at least partially due to the high adoption rates of heat pumps. Heat pumps are a very efficient technology that provide many benefits and cost savings to customers. However, because they cannot function at very low temperatures, customers are also converting to backup electric heating systems. Because peak demand generally occurs at low temperatures, we have a greater load for peak demand than we used to. This is likely to occur at even higher rates if and when the price of oil increases. This opens up opportunities for demand response.

Demand response measures allow for selectively removing demand from the grid in order to bring supply and demand into balance. Traditionally, this has been achieved by utilities reaching agreements with very large power consumers. By offering special rates to large consumers in return for the requirement to remove load from the grid when requested, the utility can balance capacity and demand. Maritime Electric has this type of interruptible load agreement with large on-Island customers. However, it should not be relied upon too heavily; if shutoffs are frequent or regular, interruptible customers may find it is not beneficial for them to have those rates and the extra capacity must be found. So while this is a good backup option, other initiatives should also be taken.

Demand response can also be deployed in the residential, commercial and institutional sectors. For example, to reduce demand during peak times, with the implementation of demand controls, the utility can shut off hot water heaters for the short amount of time in which a peak period is occurring. Since a hot water tank is well insulated, reducing demand for short periods of time will not affect its performance: customers' water will stay hot. In fact, this has already been piloted as part of the PowerShift Atlantic program, so we have an opportunity to learn from these tests and make improvements going forward. More details are provided in the Energy Storage section of this Strategy.

Controlling electric resistance heating (and possibly heat pumps) is another strategy. If the downtime per home or business is kept short, and the number of homes enrolled is large, then a significant amount of load can be shifted without affecting comfort. If smart meters are implemented, then education and outreach can play a role as well. For example, customers can choose to sign up for demand-reduction programs, in which they receive communications from their utility if a peak period is approaching, and in return for reducing their electricity use during that period, they can receive a credit on their next bill.

To avoid having any disruptions in heat output during peak events, a thermal energy storage device can be used, as has been implemented in Summerside. Expanding this option to the rest of the province could offer gains for our overall electric system. More information on this option is provided in the Energy Storage section of the Strategy.

Large commercial opportunities exist with buildings that have energy management systems. These management systems allow for a building to interact in an automated way with signals from a utility. A utility would issue a load shedding signal and the building energy management system would determine if and what load can be reduced. This is different from the situation described earlier for residential and small businesses, in which the utility would control the equipment directly.

To provide an example of what is possible, we will highlight one path of several that we could embark upon. Controlling electric hot water heaters was mentioned earlier and is a well-proven strategy used in multiple jurisdictions for many years. On the Island, approximately 30% of homes use electric hot water heaters. This translates to a conservative estimate of roughly 17,000 hot water heaters currently available for a direct load control. Since the primary goal for a demand response program is to reduce peak demand, it is important that the technology being controlled is likely to be in operation during peak load times. If it is not, then there is no load to reduce and thus no advantage. Since hot water heaters are likely to be in use between 5 and 7 pm, they are appropriate for a load control program.

While many hot water heaters will be in use during peak, not all will. So if we take a conservative assumption that 20% of the eligible hot water heaters will be available during peak (this accounts for hot water heaters that are not running or do not participate in the program), then a demand response event will have 3,400 tanks to call on to shed load. The standard hot water tank draws 4.5 kW of power, so the size of the load shed is 15 MW. This is equivalent to the total output capacity of the Summerside Harvard Street Generating Station.

Action Items

- Implement a Demand Response strategy in the residential and small-medium business sectors to control hot water heaters and potentially heating, ventilation and air conditioning equipment.
- Focus on "quick wins" in the short term, to begin an initial lowering of peak demand before additional heat pumps on the system create stability issues.
- Encourage large commercial/institution buildings to install Energy Management systems and enroll in Demand Response Programs.

THE ISLAND'S RENEWABLE ELECTRICITY RESOURCES

While the first step in controlling our energy future is reducing our energy use, increased efficiency alone is not the complete picture of our energy system. We will need to consume electricity and other fuels for the foreseeable future, so it is important to ensure our energy comes from renewable and sustainable sources to the extent possible. This section focuses on the positive changes we can make to our electricity supply. The first part addresses the central supply of electricity via our utility-level grid, and the second focuses on distributed, or consumer-level, generation.

THE ISLAND'S ELECTRIC GRID

While most of our electricity comes from New Brunswick Power via a power purchase agreement, there are options we can pursue to make our electricity system more sustainable and have greater local control. For example, Prince Edward Island has the highest wind penetration of any jurisdiction in North America and is second in the world only to Denmark. PEI is able to cost-effectively achieve such a high proportion of wind because it is part of the much larger New Brunswick Power control area, which includes New Brunswick, Northern Maine, Nova Scotia, and PEI. Examining the opportunities this inclusion provides is an important part of securing our energy future.

WIND

As a renewable energy resource, wind power offers the benefits of price stability (its costs are fixed once the investment is made) and a non-carbon-emitting, emissions-free generation resource. Given PEI's wind resource, the costs of wind power are relatively low, particularly given these other favourable attributes.

We have two options regarding wind power in Prince Edward Island: utility-scale wind projects and individual smaller-scale turbines. When comparing the two, the economics of smaller scale wind projects are much less favourable given their higher unit costs and lower energy capture rates. Because our province has such advantageous wind resources, utility-scale wind projects are a viable option for providing additional renewable capacity and energy for our domestic use. It can also open up future export opportunities, where we can sell this renewable energy to other jurisdictions that have increasing demand for renewable electricity. Exports are a favourable opportunity for our future; because our Government has first option to own on-Island generation under the *Electric Power Act,* we will be able to sell renewable electricity that is surplus to our requirements at market prices for the benefit of all Islanders.

Figure 9. Costs of Utility Scale Renewable Resources in PEI

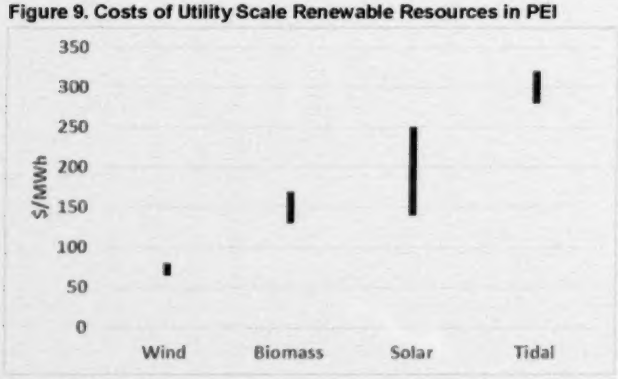
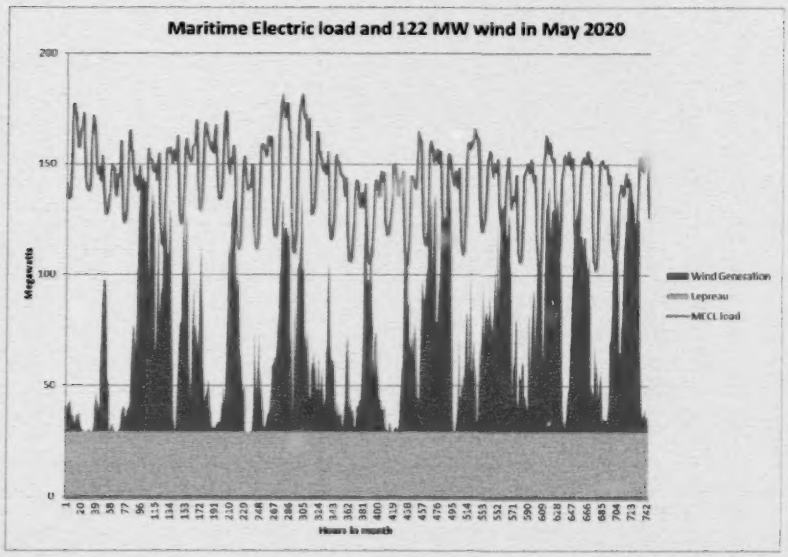


Figure 9 shows that utility-scale wind power represents the lowest-cost renewable energy resource available in PEI. This is largely due to the extent of available wind on the Island and the development of a new class of wind turbines with larger rotors, which are able to capture a higher proportion of the available energy. ***Given wind power's favourable economics in PEI, integrating additional wind will support developing the Island's full economic potential.***

Wind, however, is a variable resource, and one of the goals of this Strategy is to ensure system reliability. The cost of integrating wind power into the grid can be high if it becomes a significant proportion of the system's total electricity supply because the system will require more balancing capacity to avoid overall reliability problems when wind speeds and output drop. Currently, the Island's wind integration costs are relatively low at about $0.29/MWh (compared to some jurisdictions that pay up to $10/MWh to balance wind), based on New Brunswick Power's current tariff for regulation and frequency response service.

Given the amount of electricity generated from on-Island wind relative to system load, periods of high wind generation can result in output levels that are greater than load levels. This is evident during some periods (such as around hour 103) in Figure 10. During these periods the difference excess power would be exported to New Brunswick.

Figure 10. Illustrative Demonstration of Forecasted Wind Integration Challenges



The New Brunswick Power control area, however, already has almost 1,100 MW of wind power. A significant increase in wind could result in rising wind integration costs. This suggests that we need to consider the impacts of additional wind generation on our overall supply costs. Therefore, over the course of this Strategy, and well before the next primary Power Purchase Agreement is required, ***the Provincial Government, working with the Island's electric utilities, will explore options to integrate additional amounts of wind in PEI cost-effectively.***

Action Items

- Explore opportunities to secure federal funding for demonstration projects to expand the amount of wind power that can be cost-effectively deployed.
- Begin discussions on New Brunswick Power Transmission Tariffs with the New Brunswick Utilities Commission to provide greater clarity on integration of additional wind resources.
- Pending outcomes of the above opportunities and an agreement with New Brunswick Power, develop two additional wind farms: 30 MW in 2019 and 40 MW in 2025.

WIND ENERGY EXPORTS

PEI's wind generation that is surplus to its electricity requirements is essentially exported over the cables that interconnect PEI to the New Brunswick Power system. This wind generation can be sold in a number of possible export markets. Typically, New England offers the highest-value potential market. To promote the development of renewables in New England, each of the New England states has Renewable Portfolio Standards (RPS) that require that an increasing portion of customers' electricity requirements be provided by renewable energy resources. These Standards provide for the trading of renewable energy credits or certificates (RECs). A REC is a certificate that provides proof that one MWh (1,000 kWh) of renewable energy has been purchased. RECs can be sold or traded, and they function as an incentive to produce renewable energy (rather than focusing on emissions-reduction exclusively, as carbon-trading does). Renewable energy providers are given the credits or certificates for each MWh they produce, the related energy is fed into the grid, and the accompanying REC can then be sold on the open market. RECs are therefore an incremental source of value above and beyond energy and capacity sales.

Increases in New England RPS requirements represent about 9 TWh through 2025 or about 2,500 MW of additional wind power. To put this in context, PEI's total electricity requirements are expected to be 1.6 TWh in 2026. There is increasing skepticism regarding New England's ability to provide this amount of additional renewable generation in the region without reliance on increasingly expensive renewable energy resources (e.g., off-shore wind, which is projected to cost over $160/MWh in US dollars). Furthermore, all of the New England states have committed or expressed support for significant reductions in GHG emissions that are likely to require additional increases in renewable energy beyond these RPS targets. This suggests that the value of RECs will be meaningful and can make exports of renewable energy to New England attractive.

Experience indicates that the full value of RECs is best realized through long-term contracts. Recognizing this need for additional clean energy, the Massachusetts legislature passed legislation on July 1, 2016 calling for the procurement of 12.45 terawatt-hours per year of clean energy, which represents a meaningful opportunity for our province. We expect there to be a major opportunity for additional wind project development, supplemented by hydroelectric generation, in Atlantic Canada to meet Massachusetts' need for additional clean energy. If we contribute to this opportunity, exports would be based on our ability to provide electricity in excess of our domestic needs. Given the value of this energy in New England versus the cost to produce it on the Island, such exports are likely to lead to economic gains for the province.

While the New England electricity market represents a clear economic opportunity for additional wind power from Atlantic Canada, accessing the New England electricity market is difficult. Currently, there is no firm transmission available on the interconnections with New England from Canada. While transmission capacity can be secured in the "secondary market" as non-firm transmission, such capacity is not generally available when energy prices in New England are highest. Therefore, there is a need to develop additional transmission infrastructure into New England and to deliver energy from the border with Canada to Southern New England load centres. Securing such transmission capacity will likely require partnering with the parties that are developing transmission and generation projects to capitalize on this opportunity. ***Developing relationships with these parties will be essential to ensure that Island projects can participate.*** The Provincial Government will collaborate with other Atlantic Canada provinces to explore opportunities for renewable resources in Atlantic Canada to pursue export sales to New England.

There are also transmission bottlenecks on the New Brunswick Power system. These bottlenecks limit both the ability to purchase energy and capacity from New Brunswick when it is economic to do so, and the potential for electricity exports from the Island to New Brunswick. Because this is a regional and export issue, ***the Government will work with New Brunswick Power and other parties to evaluate strategies to increase transmission capacity around Moncton***.

Another issue affecting the ability of Island wind projects to compete to sell renewable energy in New England are transmission tariffs that need to be paid in PEI *and* in New Brunswick. These tariffs are for the use of the corresponding utilities' infrastructure. ***This add-on of transmission rates is an issue that also affects renewable energy projects in Nova Scotia as well as Newfoundland and Labrador and is therefore an important regional renewable energy policy issue.*** The Provincial Government will work with other Atlantic Canada provinces to assess strategies for reducing the pancaking of transmission rates.

A fourth issue associated with participating in the New England electricity market is the administrative complexity associated with doing so. Transmission service needs to be reserved and scheduled for the anticipated project output, which requires reliable forecasts of wind output in order to minimize transmission costs unless we can improve our ability to balance output with another flexible resource such as hydro. The various state RPS programs have specific requirements that need to be addressed for renewable resources from adjacent control areas to be qualified as renewable energy resources and to allow the incremental value of these associated RECs to be realized. These typically include demonstrating the transmission path that will be employed, ensuring that energy is also delivered to the system operator's control area, identifying the "tags" that are used to track electric energy flows, and participating in the New England system operator's Geographic Information System. ***The Provincial Government will work with other Atlantic Canada provinces to explore strategies to assist renewable energy project developers in efficiently complying with these requirements***.

Action Items

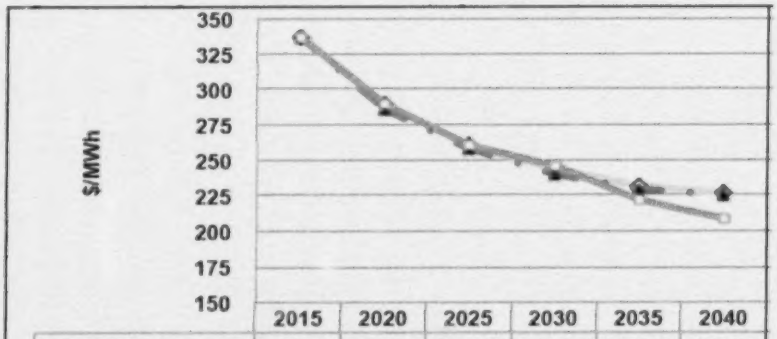
- Explore and develop relationships with transmission and generation project partners to enable the province to take advantage of expected future export opportunities.
- Work with other Atlantic Canada jurisdictions and additional parties to develop and finance strategies and approaches for mitigating barriers to wind energy exports from Atlantic Canada to New England, including:
  - Reducing transmission rate add-ons,
  - Reducing transmission bottlenecks, and
  - Exploring strategies to allow renewable project developers to efficiently comply with the various requirements for imports into New England.

TIDAL

Tidal power is receiving increasing attention. The magnitude of tides in the Bay of Fundy suggests that Atlantic Canada has an attractive in-stream tidal resource. There are a wide range of technologies under development, indicating the relative immaturity of the industry. However, recognizing the potential, and in an effort to advance the technology, Nova Scotia is targeting the development of 15 to 20 MW of in-stream tidal "on the path to reducing cost". The federal and Nova Scotia governments are supporting the Fundy Ocean Research Center for Energy (FORCE), which has four berths for testing in-stream tidal technologies.

While Nova Scotia estimates that up to 2,500 MW of in-stream tidal can eventually be developed without a significant environmental impact, Prince Edward Island's tidal resources are not as favourable as Nova Scotia's. Figure 11 reviews the projected levelized cost of energy from in-stream tidal resources. As indicated, even with projected reductions in tidal energy costs, ***tidal is still forecast to be considerably more expensive than other renewable energy resources for the foreseeable future***. Previous research had suggested that the Northumberland Strait area of the Island offered some tidal energy resource potential. Further analysis of this region indicates that the maximum tidal currents are weak, less than 2 knots, and well below the benchmark flow speed of 4 knots for present-day technology.[12] Therefore, the Provincial Government will continue to monitor developments with respect to tidal energy, in particular the potential for meaningful cost reductions. However, in terms of concrete actions, there are other, more cost-effective, actions we can take in the next ten years.

Figure 11. Projected Levelized Cost of Energy for In-Stream Tidal



	2015	2020	2025	2030	2035	2040
Demonstration	336.46	289.30	260.73	243.28	231.39	226.32
Early adoption	336.46	285.96	258.24	239.84	229.09	224.95
Late adoption	336.46	289.30	260.73	245.89	222.26	208.73

Action Item

- Continue to monitor developments with respect to tidal energy, focusing in particular on its potential for becoming cost-effective in PEI.

[12] *Prince Edward Island Phase 1a Tidal Energy Resource Assessment*, Luna Ocean Consulting Ltd. and Acadia Tidal Energy Institute, June 13, 2016.

SOLAR

Prince Edward Island has relatively modest solar resources, but with dramatic declines in costs, solar technology is approaching a level at which it could be cost-effective in the near future. Utility-scale solar costs on the Island today are over twice those of wind, but costs are decreasing dramatically. While on-Island exploration of utility-scale solar projects have not yet resulted in a proposal for a cost-competitive project, recent advances suggest that utility-scale solar is not far off. Within the timeframe of this Strategy, larger solar projects are likely to be cost-competitive with wind generation, which as a more mature technology is experiencing less dramatic cost declines. Similar to wind, solar's costs are largely fixed and therefore provide price certainty to customers. As a non-emitting renewable resource, solar also has no direct GHG emissions and would reduce PEI's reliance on imported energy. Solar is also a mature, proven, and reliable energy technology with a low technology risk.

Furthermore, with a distinctly different, more stable output profile than wind, solar integration costs are not likely to be an issue in the near term. In fact, the two renewable resources are in many ways complementary. However, one drawback is that, with peak loads in PEI typically occurring in the winter early evening, solar PV is unlikely to assist with reducing our need for peak capacity resources.

Nevertheless, solar is likely to play an important role in our future energy supply. We strongly believe that the future opportunities presented by solar means we should begin to consider siting policies for larger ground-mounted solar projects. This will ensure we avoid land-use conflicts once the technology and related costs are feasible for us to pursue. We will also pilot a utility-scale project if it becomes cost-effective to do so.

Action Items

- Develop siting policies for larger ground-mounted solar projects to avoid land-use conflicts.
- Monitor advances in storage technology and cost reductions in utility-scale solar and pilot test projects once they are cost-effective and peak capacity concerns are addressed.

DISTRIBUTED GENERATION

In addition to utility-scale generation options, we must examine the very real present and future opportunities of distributed generation, in which individual facilities and buildings generate enough energy for their own needs. Given cost reductions in solar, energy storage and other low impact technologies, distributed generation is receiving increasing attention and ultimately adoption by customers.

ROOFTOP AND GROUND MOUNT SOLAR

PEI's *Renewable Energy Act* provides for net metering, whereby customers can install small renewable energy technologies (up to 100 kW) at their home or facility and only pay for the balance of electricity they use from the utility (calculated when the consumption and their supply meter numbers are combined). In essence, participating customers realize the retail price for energy that they supply to the utility up to a maximum of what the customer uses during the following 12 months. Net metering is widely used to promote the

development of rooftop solar. Details around the program design vary from jurisdiction to jurisdiction, but the basic concepts are similar.

There are almost 70 residential solar PV systems in Prince Edward Island that are involved in a net metering program. This is a relatively high number given current economics and expected uptake, demonstrating Islanders' strong commitment to renewable technologies as well as local installers' focus on making the systems as affordable and cost-effective as possible. With continued declines in the cost of solar PV systems, we expect these systems will become more common in the future, even without specific incentives or rebates being provided. Local installation costs suggest some customers are achieving less than a ten-year payback now. This means that the Island is already a leader in some ways in regards to solar.

While incenting a greater uptake of distributed solar appears to be an attractive renewable option due to its requirement for local installers and reduced need for imports, we must look at all the impacts of the decisions we make. By reducing the amount of electricity revenues from participating customers (which can equal zero, even though they require the utility to supply electricity as back-up), net metering can increase the rates of non-participating customers as a result of lower contributions to fixed electricity system costs (see the figure to the right).

The Economics of Net Metering

- With net metering, participating customers receive the full retail electric price for every kWh of electricity that they generate up to their cumulative energy consumption for the following twelve months. A critical determinant of the value of the energy provided by net metering is the wholesale supply cost that can be avoided from such energy (not the retail cost). In Prince Edward Island, the total wholesale energy supply cost is approximately 8 cents per kWh. With the retail rate for Maritime Electric residential customers 13.56 cents per kWh for the first 2,000 kWh per billing period, Maritime Electric receives about 5 cents per kWh to cover the fixed costs of serving customers. Assuming that solar PV systems are sized at 6.5 kW and operate at a 14% capacity factor, customers who do not install solar PV systems must absorb the cost of $422.50 per year, per system installed. A net metering cap of 2% of total sales (approximately 2,800 systems) would therefore have a 0.6% rate impact. For a typical residential (urban) customer consuming 650 kWh per month, this would represent a monthly bill increase of about $.71 to cover the costs of the installation of the 2,800 systems.

Solar is a renewable energy source that provides local jobs and reduces imports. Therefore, we do not want to discourage it. With an expected uptake in solar systems in the future, however, ***we will need to ensure that we have appropriate policies in place prior to any adverse impacts being seen***. A complete analysis must be conducted at a system-wide level to determine impacts on both solar and non-solar customers, and to determine the optimal way to integrate this positive, beneficial technology into our grid while avoiding pitfalls faced by others.

Because of solar's multiple benefits, until these larger considerations are addressed, we do not want to hinder the efforts of those who are able to install it. Given that the costs of solar are largely committed upfront, financing costs of installing solar can have a significant impact on its attractiveness to customers. There are a range of strategies that can be employed to reduce these financing costs (either as a whole or on an annual basis) or increase access to financing. A few examples include:

- Government back-stopping loans through a reserve fund (which can increase the lending periods financial institutions are willing to offer);
- Offering low-interest loans to customers through a Provincial Green Bank or other similar means; and

- Third-party ownership of the solar PV system, where a customer avoids the upfront cost and responsibility for maintenance resides with the third-party owner, but the customer can receive a share of the benefits offered by lower electricity costs.

Maintaining* and streamlining *the current Community Economic Development Business financing model is also an important initiative. The fund could play an increasing role in our energy supply in the future.

There are also actions we can take to ensure we are ready to integrate solar in our electricity supply system as more individuals and businesses decide it is the right decision for them. For example, we can ensure that new building construction is "solar ready" and effectively reduces the costs and maximizes the benefits if a homeowner elects to pursue rooftop solar even after purchase. Specifically, programs can be developed to outline the benefits to builders of making homes solar ready. Alternatively, building codes can be developed that require, or tax credits can be offered that reward designs that lower the costs of building a rooftop solar system. The building design variables to influence include:

- Roof pitch and orientation
- Layout of chimneys and roof vents to prevent shading
- Roof load bearing specification
- Designated roof mounting points for PV array
- Installation of electrical conduit from main electrical panel location to roof
- Specification of main service panel and circuit breakers to accommodate PV
- Space near the main electrical panel for inverters and other equipment

We will consider building design initiatives focused on enhancing solar readiness for homeowners wishing to install rooftop or ground mount solar systems in the future.

In addition, as energy storage options are improved and enhanced, solar generation may assist in reducing peak demand, since energy can be collected at a time of low energy use and stored for release during periods of high energy use. We must also remember that it is better to reduce the amount of energy we need first, and then ensure that what we do need is renewable and sustainable. For this reason, ***we will explore ways to develop integrated programs that assist customers to reduce their energy use first and then to install solar. We will also explore ways to maximize their benefits by installing storage options at the same time.***

Action Items
• Examine and implement a financing option for distributed generation (solar and wind).
• Promote and streamline the Community Economic Development Business model.
• Research and consider programs to ensure that new construction is solar ready.
• Research and develop integrated programs that encourage a comprehensive, facility-based approach to energy, including energy efficiency and the adoption of distributed generation.
• Research and develop integrated programs that encourage energy storage technologies in combination with solar. These could include components such as time-of-day pricing with solar, an energy thermal storage system, and/or net billing.

ENERGY STORAGE

Prince Edward Island can employ a range of strategies to facilitate the integration of variable, renewable generation. Not surprisingly, given our high wind penetration rate, we have already been pioneering some innovative energy storage strategies. These include a thermal energy storage program currently being implemented by the City of Summerside, the PowerShift Atlantic program to adjust customer loads to better integrate wind, and the evaluation of battery storage by the Wind Energy Institute of Canada.

Energy storage projects can provide a number of diverse benefits. They can help us to balance our electricity system and integrate wind and solar. Storing inexpensive power when it is not needed and using it when it can replace more expensive power is the basic function of energy storage. For example, when wind turbine output is high, or when the sun is shining, energy storage technologies can absorb the additional energy, and when wind output is low or the sun is not shining, these devices can release the energy that has been stored. Technologies with sufficient storage capability can also have "capacity value", meaning they can be operated during peak periods to meet our requirements and, because we can trust they will be available during peak, allows us to have additional local, renewable generation on the Island. For energy storage technologies to provide such value, they must be able to produce the stored energy for several hours.

Any electricity supply system requires a number of ancillary services to function properly. Ancillary services are services that are required to ensure our electricity supply can always meet demand. These services are needed to keep electricity supply and demand balanced and have traditionally been provided to system operators by generating facilities that can be ramped up to meet demand quickly (such as Maritime Electric's combustion turbine). However, going forward, they can also be provided by specific kinds of storage facilities, since many energy storage technologies are fast-responding and can be used to balance supply and demand and therefore ensure that power quality and system reliability is maintained.

If new supply is needed to meet demand in an area with growing peak demand, we can meet it in several ways: by building new transmission lines, and/or by building new generation in the area, or by building a storage facility to eliminate or postpone the need for new generation or transmission investment. This option can provide the lowest GHGs, assuming that the energy charging the storage facility is renewable, and can be cost effective, pending continued declines in the costs of energy storage technologies.

UTILITY-SCALE ENERGY STORAGE

Of particular relevance to Prince Edward Island, energy storage is critical for us to be able to integrate intermittent renewable energy resources. Energy from renewables such as wind and solar is available to the grid only at certain times, when the resource is available. If it is available at a time of low demand, the system operator may be forced to curtail generation from wind. Or, if available, energy storage options can be employed. However, it is important to note that while batteries have been around for a long time, utility-scale storage is still in its relative infancy, which must be taken into account.

BATTERIES

The Wind Energy Institute of Canada (WEICan) is currently utilizing its 2-MWh battery for different purposes to gain an understanding of the technical and economic implications of using storage to provide various services, including time shifting, demand and energy avoidance on a wind farm, diesel displacement, and frequency regulation (automated generation control).

Batteries are highly responsive and can be used to provide the services required to keep the system in balance by increasing or decreasing output in response to signals from the system operator. The current WEICan battery is relatively modest, with 2 MWh of storage capacity and a 1 MW inverter, which determines its maximum output. However, because our electricity needs are over 1,400 MWh and over 250 MW at peak, its ability to influence market conditions is limited. With its output limited to 1 MW based on whether it is charging or discharging, this battery has at most a 2 MW impact on the system, which is not generally enough to significantly affect system operations (for example, avoid operating a unit) and does not produce the greatest benefits.

This is where Islanders' desire to leverage our small size and flexible nature is an asset. ***Given the relatively small size of our electricity system, a modest increase in battery capacity could create an opportunity to test and better demonstrate the ability of batteries to reduce the costs of integrating variable generation such as wind and solar.*** Because many utilities and jurisdictions are looking to the future of battery storage, doing so will help us to develop our knowledge and expertise that we may be able to leverage elsewhere. Furthermore, innovative testing options such as this may be eligible for federal funding opportunities since the value of successful installations would be applicable to many other areas. We will therefore work with WEICan to explore strategies to demonstrate the ability of batteries to cost-effectively integrate additional amounts of wind generation.

Action Items

- Work with WEICan to expand battery storage at the wind energy test site or elsewhere on the Island given that storage in load centres can defer transmission and distribution investment and demonstrate the value of batteries to cost-effectively integrate additional amounts of wind power.
- Explore strategies to secure funding from the Federal Government for such energy storage projects.

ASSESSING THE ECONOMIC VALUE OFFERED BY ENERGY STORAGE INCLUDING BATTERIES

Given the diverse services that batteries can provide and how much the performance of different battery technologies differ, it is important the cumulative value of the full range of possible services be considered when assessing the economics of the technology. For example, lithium ion batteries, which are commonly used in home electronics where high energy density (a high energy storage level for the weight of battery) is desired, offer the most attractive economics for many applications. However, when looking at grid-level uses, lithium ion batteries are only cost-effective when they can respond in real time to keep supply and demand in balance by increasing or reducing energy output, and this is only in markets that recognize the incremental value offered by the higher quality of service that they provide.[13]

Because the cost of this technology is declining, we anticipate that lithium ion batteries will represent a cost-effective supply resource for numerous other services within five years. Economics in PEI are likely to be favourable sooner, given our relatively low electricity requirements and their additional value of incorporating renewable generation options. The net effect of our small size is that conventional technology (e.g., combustion turbines that are used to provide capacity and respond to system contingencies) can't realize economies of scale that are available elsewhere.

Batteries can also function as a capacity resource. When the Charlottetown Thermal Generating Station is retired, which we expect will be no later than 2020, and very likely earlier, our province may face a capacity constraint. If we make the proper investments in research and resources now, battery storage combined with demand response and energy efficiency may be able to meet this need cost-effectively by 2020, avoiding the need for additional fossil-fuelled generation from New Brunswick or the building of new, non-renewable generation on the Island. Therefore, we must monitor cost reductions in battery technologies, test new installations with partners such as WEICan, and work with the Island's utilities to evaluate whether such an energy storage option could be implemented in a manner that will facilitate renewable energy integration as well as provide capacity during peak demand periods and in case of system outages. This is another excellent opportunity for the Island to test and demonstrate new technologies and concepts.

With wind power typically representing the lowest cost renewable energy resource in many Canadian jurisdictions, and with Prince Edward Island having the highest wind penetration of any North American jurisdiction, ***our province has an opportunity to explore and test strategies to reduce the costs and expand the integration of additional wind on our system***. This will reduce the electricity sector's GHG emissions and provide us greater autonomy over our electricity supply. Lessons learned here could be employed elsewhere, which could create opportunities for the Federal Government to fund strategies that could be tested and, if proven successful, could be employed more broadly across Canada. We will explore opportunities to secure federal funding for energy storage demonstration projects to expand the amount of wind power that can be cost-effectively deployed in PEI.

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[13] Lazard, Levelized Cost of Storage. Such a market is PJM, which covers 13 states and originally encompassed Pennsylvania, New Jersey, Maryland and the District of Columbia

Action Items

- Monitor cost reductions in battery technologies and assess the implications of such on their potential application in PEI.
- Explore the use of batteries to address peak power needs, to integrate additional wind power and leverage federal financial support for the Island as a testing ground with local and export benefits.

DISTRIBUTED STORAGE OPPORTUNITIES

ELECTRIC THERMAL STORAGE

Currently, the City of Summerside is promoting electric thermal storage (ETS) under its "Heat For Less Now" program, which uses MyPowerNet technology to allow it to more effectively incorporate its contracted and local wind power. Heat For Less Now reduces heating costs for customers by offering a lower rate of $0.08/kWh in exchange for allowing the utility to remotely control when water heaters and thermal energy storage devices should be consuming energy and when they should be releasing stored energy, based on existing wind levels. This allows Summerside to realize greater value for surplus wind than selling the energy in the export markets at times of low demand (and low prices). It also reduces GHG emissions that would otherwise result from using oil, propane and electricity from non-renewable sources. Summerside has used the program to reduce the amount of surplus wind power that is exported, therefore increasing local use, and the value it receives for this energy.

This program could have multiple benefits if applied to our entire province, including the ability to reduce our peak demand as well as integrate additional wind and solar generation into our electricity generation mix. It may, however, require regulatory or infrastructure changes to ensure the appropriate technology is in place and easy for customers to implement, including communications-enabled meters for optimal effectiveness. ***We will therefore work with Summerside, Maritime Electric, IRAC and Efficiency PEI (or an energy efficiency utility) in launching a province-wide ETS program that provides customers with benefits and is cost-effective***.

GRID-INTERACTIVE WATER HEATERS

Another energy storage technology that has been utilized for a number of years, but is being re-imagined to assist with variable energy integration is electric water heaters. In this new concept, the system operator (or a local utility) control grid-interactive water heaters in real time and respond to signals that address our energy needs; the heaters use energy to heat water prior to peak periods and then are shut off during times of peak energy use. Because the heat from the water is not lost in the time it takes for the peak to be over, customers do not even notice when this is occurring.

This controllability makes these water heaters valuable resources because they can be called upon to address system requirements without interfering with a customer's everyday needs. In addition to heating water when power is inexpensive and reducing electricity demand during system peaks, a grid-interactive water heater can help integrate renewables (because they can run during periods of high energy generation, absorbing surpluses, and shut off during periods of low generation). In addition, they can provide services to the electric grid such as frequency regulation.

The technology to make water heaters grid interactive is readily available. In fact, it has already been successfully employed during the PowerShift Atlantic pilot program, in which Maritime Electric and other Maritime utilities participated. The program was a demonstration project to determine if customer loads could be shifted using smart-grid technologies to more effectively integrate wind generation and to determine if this could be done cost-effectively. Unlike typical Demand Response programs, PowerShift Atlantic used load and wind forecasting and aggregation capabilities to perform near real-time continuous load shifting of commercial and residential loads and provide ancillary services to the grid.

The program demonstrated that it could reduce the requirements for ancillary services from existing generation assets. In this way it has the potential to reduce the costs and emissions associated with the integration of wind energy in the Maritimes, as well as to increase the amount of renewable resources that can be cost-effectively developed. The program also provided a number of valuable lessons, which should be considered if it is to be expanded. Of greater promise is encouraging customers to install this technology when they are replacing or installing their electric water heaters, which will dramatically reduce the costs of realizing this capability. ***Providing incentives for customers to purchase water heaters that have grid-interactive capabilities is one way to encourage its deployment. In addition, the Province will work with appropriate Federal Government committees to explore the possibility of appliance efficiency standards requiring that new electric water heaters have grid-interactive capability.***

Action Items
• Work with Summerside, Maritime Electric, IRAC and Efficiency PEI (or an energy efficiency utility) in launching a province-wide ETS program.
• Develop an appropriate incentive structure to encourage customers to purchase grid-interactive water heaters and/or install relevant technology to allow them to participate in a permanent peak reduction water-heater program.
• Develop additional programs or options for facility-level storage, including exploring options for batteries and storage options other than water heaters.
• Explore with the Federal Government whether appliance efficiency standards should require that new electric water heaters have grid-interactive capability.

BIOMASS

Biomass is an energy source derived from organic materials such as plants or waste. It consists of low-to-no-carbon sources, which makes it an important resource for consideration in the Provincial Energy Strategy. In addition, it is currently used both for power generation and for heating in the province. For example, in 2014, 30% of Island households used firewood as a supplementary heating source. An additional 1.4% of homes are using wood pellets as their primary heating source, and 22 facilities such as schools have converted to wood chips for their primary heating source, with three more planned for 2017. The Charlottetown district heating system uses 36,000 tonnes of wood chips per year, for about half of its fuel input.[14] Wood heating sources are considered carbon neutral, and they are renewable, which makes them attractive options for heating. However, their economics are subject to market variances. For example, as of the time of developing this Strategy, low oil prices and concurrent increases in pellet prices (from about $4 to $6-7 per 18 kg bag in recent years) mean that pellet heating is now on a par with oil heating in terms of energy cost (see Table 2). Pellet furnaces also have higher (double or more) installation costs than oil furnaces. While pellet stoves are less expensive than furnaces, they can only displace a portion of oil heating.

Similarly, the energy service model (in which energy service companies provide fuel and system operations and sell the heat produced at a contractually agreed-upon rate) used to heat public buildings with wood chips is currently leading to higher heating costs than heating with oil. While biomass heating addresses GHG concerns, it is not always a cost-effective option in the shorter term, which discourages the further adoption of wood heating. Only firewood is still considerably cheaper than oil heating, at about half the cost per GJ. Oil prices, however, are unlikely to be sustained at these low levels over the long term. Also, oil is currently subsidized through an HST exemption, which creates a non-level playing field (see Table 7).

In addition, we must examine the source of supply related to biomass and our ability to have control over our energy sources, as well as air quality concerns that can be a result of some biomass sources such as an extensive use of wood stoves in urban areas.

Table 2. Comparison of Current Costs Related to Wood and Oil Heating and Fuels in PEI

Cost Type	Wood	Heating Oil
Capital cost	Pellet furnace: up to $20,000	Oil furnace: <$10,000
Fuel cost	Pellets: $20+/GJ ($6-7 per 40 lb bag)	Heating oil: $21/GJ ($0.76/L)
Fuel cost	Firewood: $240/cord	Heating oil: $422 (560 L)
Heating cost	Wood chip heating (service model)	Equivalent to oil cost of $1/L

[14] See http://www.biomasscenter.org/resource-library/case-studies/community-district-energy/city-of-charlottetown

COGENERATION

PRODUCING ELECTRICITY FROM WOOD

Cogeneration using biomass provides an opportunity for producing carbon-neutral power and heat for specific customers. However, to use biomass for cogeneration, two key issues need to be addressed: cost-effective biomass supplies in the quantities required, and adequate revenue from power and heat sales to finance the system. Adding power generation units to biomass boilers increases the capital cost of such systems. Power production with steam turbines requires constant engineering supervision, which makes such systems cost-effective only at large scales (such as 20 MW and more). Such a large installation would require substantial amounts of inexpensive biomass fuel (about 140,000 tonnes of wood chips per year with an approximately 45% moisture content for a 20 MW plant). This is greater than is currently used in PEI for heating and would certainly affect our current ability to heat buildings with wood chips. Wood waste is not produced in quantities large enough to make biomass cogeneration systems feasible on the Island. Furthermore, large biomass power and cogeneration is not competitive with either wind or imported electricity from New Brunswick for our province at this time.

Power is produced from biomass at the PEI District Energy System, which is a small back pressure steam turbine with 1.2 MW output. This could in theory be increased in size but currently, no further expansion of the District Energy System is planned. There may be a few select opportunities for small-scale power generation in combination with new district heating systems, with one being implemented for nine Tignish buildings[15] and one under consideration for Summerside. Such undertakings have high capital costs and usually depend on cost sharing between public or with private entities, so to achieve cost efficiencies, ***any larger works related to replacing water and sewer systems should be examined in combination with expanding or creating district heating networks. Significant savings can be obtained when carrying out such work in combination***.

Plant-based biomass from the agricultural sector is much more problematic than wood when combusted. It is also often more expensive to collect, prepare, and transport and therefore may not be a suitable fuel for most applications. Possibly, some plant-based fuel could be used at the Charlottetown system, which has effective flue gas emission controls. We are not, however, recommending it as an opportunity to pursue for smaller and residential wood heating systems.

[15] See http://www.journalpioneer.com/News/Local/2016-04-05/article-4488223/Funding-warmth/1

PRODUCING ELECTRICITY FROM BIOGAS

As outlined below in the chapter on transportation, there are digester feedstocks from both the agricultural and municipal sectors that could be used to produce biogas. Biogas is a mixture of methane and carbon dioxide that can be combusted in an engine to produce electricity, and waste heat can be used to heat buildings or greenhouses and/or heat the digester during winter. Digesters currently exist at Cavendish Farms and the Charlottetown wastewater treatment plant; however, the gas is only used to produce process heat and not electricity. Only the Agra-West starch plant in Souris currently operates a digester facility that produces electricity.

There is no potential at our existing landfills to produce biogas since they are either old (little gas production left) or will not produce much gas due to our province's effective organics separation. As such, for the most part, we could only produce biogas from manure at large farms and the organic material processed at the Central Composting Facility. The cost of doing so, however, would exceed the cost of other power generation options such as wind.[16] With an incentive structure reducing the cost of digesters or providing extra income from power production from these facilities (or by taking waste materials), cogeneration from biogas could become a more attractive option for Islanders. Alternatively, biogas can be purified and sold as methane for transportation fuel, as discussed in the Transportation section of this Strategy.

While there is no one "right" answer, our leadership in the area of waste separation in combination with our size means the Island does not have enough source material to use biogas for all purposes. Because we have other options and opportunities for renewable and sustainable sources of electricity, it is less critical that biogas be used for this purpose. This is why we focus on it below for the transportation sector instead.

Action Items

- Explore the extension of the Charlottetown district heating system.
- Consider new district heating facilities at other locations, also examining the feasibility of small-scale cogeneration.

[16] According to a Holland College study (*Anaerobic Digestion – Is it Feasible on PEI Dairy Farms?*, February 14, 2016), at least $0.14/kWh would need to be paid for electricity from smaller on-farm digesters to bring their payback to under ten years.

HEATING FUELS

WOOD CHIPS

Wood chip heating is not suitable for the residential sector; only medium to large-scale chip boilers exist, and the logistics and operational requirements of wood chip boilers require sufficient storage and on-site expertise and regular system supervision. In addition, we have limited supplies of low-cost wood for chipping available on the Island, and several chip boilers in PEI have been abandoned in the past due to operational problems. For our existing wood chip boilers, Provincial policy has been to contract operations out to energy service companies.

In terms of supply, most of the 250,000 hectares of forest on PEI is owned by approximately 16,000 private woodlot owners; the remainder (12%) is managed by the Province. Total merchantable (not used for energy) wood volume is estimated at 28 million m^3,[17] with around 400,000 m^3 being harvested annually (about 1.4%) – considerably less than the maximum harvest levels above 600,000 m^3 occurring around 2003-2004. We expect at least 20% of this volume to be available as non-stemwood[18] for chipping, which would amount to approximately 70,000 tonnes per year, in addition to the approximately 60,000 tonnes currently used.

Thinning just three per cent of our forests could provide enough wood chips to heat 32 public buildings for 10 to 15 years.[19] However, forest thinning is currently only occurring at a small scale (about 500 ha per year), which does not represent a large source of wood for energy. Thinning models that allow harvesting companies to sell valuable wood for pulping or other such uses and low-value wood as chips may actually improve our forests over time while providing additional amounts of wood fuels. To ensure wood chips delivered to governmental facilities are sustainably harvested, the government has a policy in place that requires fuel wood to be sources from sustainably managed forests. In other words, the wood chips used today are a by-product of sustainable forest management, and the revenue created from the chips contributes to the financing of sustainable management practices. To increase the amount of wood available from sustainable management practices, ***we will*** look at increasing local capacities to enhance sustainable forestry practices. We will continue to use pilot projects in public forests in order to increase local capacities to undertake thinning activities.

The 2010 *State of the Forest Report* cautions us to make wise choices with respect to choosing sustainable harvesting levels, projecting a decrease in standing volumes (though not the forested area) over the coming century. The most age-balanced and ecologically valuable forest would result from a scenario based on harvesting levels similar to the current low levels (about 2/3 of levels seen around 2004). In order to achieve this sustainability goal, then, ***we could increase the use of non-stem wood and wood from forest thinning for chipping to enable current wood chip heating to double or triple in a sustainable manner***. Because of this opportunity, we will work to install additional wood heating systems at provincial and/or municipal facilities. ***We***

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[17] *PEI 2010 State of the Forest Report*

[18] Stemwood or roundwood refers to the stem without branches and roots

[19] Mathieu Arsenault of PEI BioHeat, http://www.cbc.ca/news/canada/prince-edward-island/forests-pitched-to-heat-government-buildings-1.1342095

will also adopt regulations that require the clean separation of waste at construction and demolition sites. This will ensure that less waste goes to landfill (wood waste currently used at the Charlottetown District Energy System may not have to be separated) and provide a way to reuse some building components, as well as a source of clean and dry wood for chipping and subsequent use in wood heating systems.

Action Items

- Install up to an additional 40 (above the existing 20) wood heating systems at provincial and other public facilities.
- Look at increasing local capacities to enhance sustainable forestry practices.
- For new wood chip heating installations, negotiate with energy service providers to obtain contracts more competitive with oil heating.
- Adopt regulations that require the clean separation of waste at construction and demolition sites. This will ensure that less waste goes to landfill, provides a way to reuse some building components, and provides a source of clean and dry wood for chipping and subsequent use in wood heating systems.

FIREWOOD

Firewood use has been fairly constant over the past decade. One reason is that the cost of firewood is currently approximately half the cost of oil heating. However, one-third of people interviewed during the *2014 Home Heating Survey* mentioned that wood splitting and hauling is too much work, with almost 30% saying wood is not their preferred option due to the dirt involved. This suggests it would be difficult to substantially increase firewood use on the Island, even with higher oil prices. We therefore do not see it as requiring specific action items in the Energy Strategy.

PELLET HEATING

According to the 2008 Energy Strategy, tax exemptions, low interest loans and other financial incentives for wood heat systems (wood and wood pellets) increased the popularity of these systems in Prince Edward Island and resulted in a larger market for wood and wood pellets. Currently, Efficiency PEI incentivizes residential and multi-unit residential wood heating systems with 10% of installed costs. Most pellet heating on the Island, however, is based on pellet stoves, rather than pellet central heating (boilers and furnaces). ***Adopting policies to encourage pellet central heating could create enough demand to enable bulk delivery of pellets. Bulk delivery would increase convenience for customers as well as enhance the attractiveness of pellet heating to the commercial and institutional sector***. However, little information is available on the more than 7,000 general service electricity accounts on the Island. ***A survey focused on energy sources used for heating in the PEI commercial sector would help identify biomass potential, as well as provide information for other areas of the Strategy.***

Pellets must be imported since there is no local supply. While we have examined the potential of developing supply, to be competitive, a pellet plant would have to produce about 100,000 tonnes per year and at least partly use cheap wood residue from other forest product activities. Smaller plants can be economic if there is a

supply of dry and clean wood residue from sawmills or joineries, neither of which exists in high enough quantities on the Island. If adopted in higher amounts, pellets could replace imported oil. While they would still need to be imported, they could be sourced from within Canada, including other Atlantic provinces or Quebec.

Because pellets are imported, they are not subject to the same resource limitations as local wood chips and could in theory cover a much larger part of the heating market (up to the 50% of the residential market currently heated with oil, as well as commercial buildings). They are more expensive than wood chips; however, they cause fewer problems with fuel storage (e.g., freezing in winter) or fuel provision (auger blockage). They also do not require the energy service model for their operation.

Given the limitations of increasing the use of chips and firewood, pellets represent the most significant alternative to the increased use of electric heating for those homes currently heating with oil (see Figure 12 for an example).

Figure 12. Pellet Heating Case Study

Northwest Territories Case Study
In the Northwest Territories, the use of pellets for heating started with a commercial system being installed at the North Slave Correctional facility in Yellowknife, in 2007, displacing half a million liters of heating oil per year. Pellet use has grown from zero in 2006 to 30,000 tonnes in 2015, including approximately 1,000 residential pellet furnaces, an unknown number of pellet stoves, and 80 commercial-size systems. Incentives for residential pellet heating ($700 for stoves and $5,000 for furnaces) are complemented by commercial incentives of $15,000 and community heating incentives up to $50,000 per system. The cost of pellet bags is similar to PEI (about $6/bag) and for bulk pellets, it is between $300 and $540 per tonne,[20] the lower price being applicable to Yellowknife. Assuming growth of the pellet industry over eight years, the Northwest Territories has seen almost a doubling of residential and commercial-size installations each year. If this pattern could be replicated in PEI,[21] the province would see an uptake of up to 45,000 tonnes of pellets (triple the population of the Northwest Territories but only half the heating degree-days).

While electric heat is an important component of our future and opens up many opportunities for efficiencies because of heat pumps, it is currently causing concern for our winter peak growth. When oil prices rise again, this concern could become ever greater. ***Pellet systems are therefore an alternative to switching to electric heat, with the benefit of not contributing to higher winter peak loads.*** In the future, commercial systems could even function to *reduce* peak load.

The widespread introduction of wood pellets would require a local distributor that has bulk pellets delivered by B-Train truck (belly dump trucks feeding into an auger feeder) to a silo storage site, and that would operate the

[20] Burns, Mike: Biomass and the Northwest Territories

[21] When Maine introduced its incentive program, it led to 178 installations during the first six months.

pneumatic delivery trucks. In the past, this service was offered by Phillips Agri Services in Charlottetown, using animal feed delivery trucks that are also suitable for wood pellets. They are currently no longer delivering pellets, due to the high cost of bringing pellets in from New Brunswick. However, a larger market may make this business model more viable. Alternatively, large pellet users could have their own storage silos and accept deliveries by truck directly from mills in New Brunswick or from other locations. If demand were to increase, local storage silos could be installed to reduce delivery costs. Please see Appendix A for other considerations for setting up a PEI-based bulk pellet industry.

Figure 13. New Pellet Cogeneration Technology

Pellet Cogeneration System
Austrian pellet producer Ökofen is developing a commercial-scale (50 kW_{th}) pellet boiler equipped with a 5 kW_{el} Stirling engine, producing both heat and power. The Pellematic e-max is currently being field tested and should still be considered a prototype. The PEI Government, in collaboration with Maritime Electric and Summerside Electric, could work with the manufacturer to test some units in PEI. A positive test outcome could then result in a targeted program to enhance the adoption of these units by businesses and institutions with large buildings. This would combine with a strategy to enhance pellet use to displace heating oil but would also serve a strategy to address winter peak electricity use, which would be reduced by these systems. See: http://www.okofen-e.com/en/pellematic_e_max/

ENVIRONMENTAL CONCERNS

We would be remiss if a discussion about biomass did not address environmental considerations, of which there are several:

- ***Sustainable harvesting:*** Concerns about sustainable harvesting levels have been addressed above and are also addressed in the Province's Forest Policy.[22]
- ***GHG reductions:*** The GHG benefits of pellets have been confirmed in several studies.[23] Generally, transportation to PEI from neighbouring provinces will only reduce GHG benefits by a small amount.
- ***Air quality:*** Concern about air quality and dust emissions resulting from wood combustion are also raised when discussing biomass options. This concern is usually coming from experience with badly operated wood stoves, which produce visible smoke. No substantial increase in firewood use is being recommended, and the responsible use of seasoned firewood does not lead to deleterious emission levels. Wood chip systems need to be operated professionally, but this is already in effect in PEI due to the energy service model. These systems also come with efficient emission reduction devices such as

[22] http://www.gov.pe.ca/photos/original/EEF-ForPol-Eng.pdf

[23] See e.g., www.pellet.org/images/2%20-%20Warren%20Mabee.pdf; *lcacenter.org/inlca2007/presentations/55.pdf*

multi-cyclones, limiting air quality impacts. The proposed build-up of wood chip heating is not expected to have material impacts on local air quality. Finally, pellets are the cleanest wood fuel available and have very low ash content, leading to very low emissions comparable to oil burner emissions. The replacement of heating oil with pellets should therefore also not lead to air quality deterioration in PEI.

Faulty installation or low-quality stoves or furnaces can cause negative impacts in the above areas. In all cases, we will only support EPA- or CSA-certified devices with proven combustion efficiencies and low emission rates.

Action Items

- Develop a strategy to implement large wood pellet heating systems at government facilities to create a local bulk pellet delivery market, parallel to the drive towards wood chips.
- Incent the installation of CSA or EPA-certified wood pellet boilers and furnaces in commercial and residential buildings.
- Conduct a survey on energy use in the PEI commercial sector to determine the biomass potential in the province and gather additional information.
- Implement a pilot project to test pellet cogeneration systems.

TRANSPORTATION

The transportation sector is becoming an increasingly important consideration in terms of provincial fossil fuel use and related emissions. Its emissions are still growing while other sectors are reducing their fossil fuel use. According to the *2014 Annual Statistical Review for PEI*, the number of cars in PEI increased from about 66,000 in 2007 to almost 74,000 in 2014. The number of trucks (vehicles above 4.1 tonnes) also increased from about 22,000 to 25,000.

In terms of non- or reduced-gasoline-powered transportation, in 2016, only 22 electric vehicles and 280 hybrid vehicles were registered as active on the Island. As shown in Table 3, in 2006, the most recent year for which data is available from Statistics Canada, cars were used in PEI to a greater extent than the Canadian average, and public transportation significantly less. Although no recent data is available on this topic from Statistics Canada, we do not have reason to believe car use has lessened over the past ten years. However, public transport options are now available on the Island, so public transit is likely to have grown. To what extent is unknown, but it is not likely significant, particularly considering the *2014 Statistical Review* results highlighted above.

While there are valid reasons for this, such as the more rural character of our province, and a diffuse population reducing the cost-effectiveness of public transportation, this does not mean we should accept these statistics as foregone conclusions going forward.

Table 3. Predominant Means of Transport in PEI and Canada (2006)[24]

Means of Transportation	Prince Edward Island	Canada
Car, truck, van as driver	80%	72%
Car, truck, van as passenger	11%	8%
Public transit	1%	11%
Walking	7%	6%
Bicycle	1%	1%

Since biofuels are not available locally and there are technical limits to mixing biodiesel for the on-Island market, this option has not advanced since the last Energy Strategy was published in 2008. Likewise, vehicle fuel

[24] Statistics Canada, *2006 Census of Population*, Statistics Canada Catalogue no. 97-561-XCB2006012

efficiency mandates are difficult to implement apart from a more regional approach. We have therefore not included these options as a viable option going forward and are focusing on other strategies, including fuel switching, energy efficiency, urban planning, and modal changes from cars to other forms of transportation.

KEY POLICY APPROACHES

Table 4 provides a non-exhaustive overview of policies that can be used to reduce transportation energy use. Several of these are already being pursued in PEI, including public transport, bike lanes, traffic-light alignment and infrastructure improvements, such as adding more roundabouts.[25]

Many of these policies and measures will marginally reduce energy use from transportation but cannot produce deep reductions in energy use in the short term. Nonetheless, they are important because many can make significant reductions as they are implemented over years and decades. In particular, since options such as urban planning can only be implemented cost-effectively over longer periods of time, it is critical that we build the frameworks and policies now to begin transitioning as we update and upgrade our existing transportation infrastructure.

One key action to reduce fossil fuel use in transportation is to promote technologies that do not rely on liquid fuels, such as the electrification of transport, which is described in further detail below.

Table 4. Overview of Sustainable Transport Policies[26]

Key Policy Areas	Common Measures
Reduce vehicle use (mobility management)	• Bike lanes • Bike rentals • Car pooling • Public transportation • Intentional parking fees • Reduction in parking space availability and distribution • Urban planning • Pedestrian zones • Traffic calming (road design and measure put in place to reduce or slow down motor-vehicle traffic and/or improve safety) • Carbon tax • Telecommuting, videoconferencing • High-occupancy vehicle (HOV) lanes • Improved taxi/Uber service

[25] PEI Transportation and Infrastructure Renewal *Strategic Plan 2012-2015*

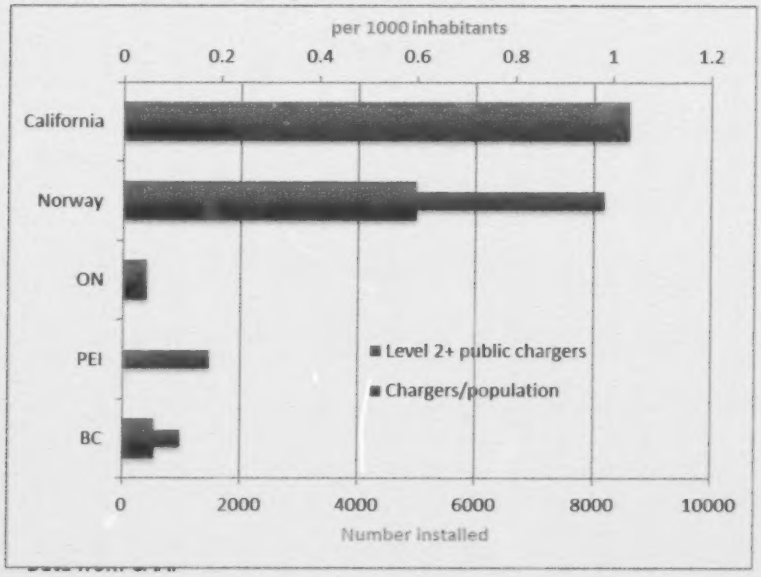
[26] See http://www.vtpi.org/tdm/index.php for a more comprehensive list and definitions

Government leadership	• Government procurement of electric vehicles • Third-party screening for green practices • Employee-targeted programs • Research & Development programs • Energy strategies • Regional cooperation • Benchmarking and tracking
Greener vehicles & practices	• Low Carbon Fuel Standards • Zero Emissions Vehicle mandates • Plug-in Electric Vehicle/Battery Electric Vehicle incentives • Driver training • Traffic light timing alignment • Anti-idling campaigns • Behaviour change and information campaigns

ELECTRIC VEHICLES

Since transportation trends and technologies are similar throughout North America, and even globally, most jurisdictions trying to reduce fossil fuel use and to rely more on local energy sources are facing similar challenges as PEI. Nevertheless, some jurisdictions have made significant efforts in order to prepare for, and encourage, the use of electric vehicles in order to address and reinforce this trend rather than being caught unprepared. For example, fast chargers allow vehicles to be partially recharged charged in minutes and make them nearly as convenient as gasoline vehicles (see Figure 14 for examples of installation rates). This also reduces range anxiety.

Figure 14. Public Fast Charging Infrastructure Examples[27]

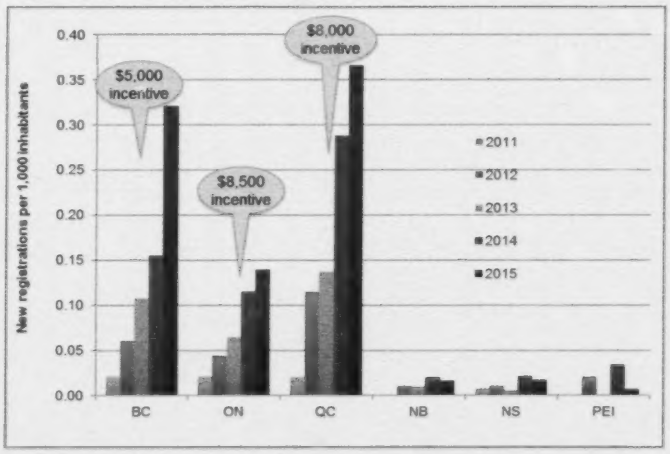


RESIDENTIAL SECTOR

While for a person who drives 60,000 km per year would see annual fuel cost savings in fuel charges of just under $3,000 (with electricity at $0.13/kWh and $1/litre for fuel and using the Ford Focus electric and gasoline vehicles as comparators), on average, Canadians only drive just over 25% of this distance.

As such, electric vehicles currently make economic sense only for those who would pay for a higher-end vehicle or who drive greater distances. As a result, uptake is currently quite low, with only 40 electric vehicles registered on the Island. Research suggests that electric vehicle sales are highly sensitive to incentives, as shown in Figure 15. While regional differences may account for some of the disparity, car dealers on the Island indicated that when incentives were cancelled for hybrid vehicles, sales essentially halted, which provides support for this assessment. Similarly, in the U.S., the states with the largest electric vehicle incentives— California, Georgia, Hawaii, Oregon and Washington—have sales shares that are approximately two to four times the national average.

Figure 15. EV Adoption and Incentives



We expect sales of electric vehicles to rise in the coming years, with performance and range increasing and costs decreasing. Tesla's announcement that it will have an electric vehicle with a range of 345 km per charge on the market by the end of 2017 starting at $35,000 USD was met with over 325,000 reservations within one week.[28]

In addition to an expected increase in uptake of electric vehicles, they are a technology that aligns well with the Island's small size. Range anxiety is less of an issue, and installing additional public chargers can make it virtually non-existent. If we so choose, we can be a testing ground for substantial penetration of electric vehicles in our market. They also align with a broader strategy to showcase a green and sustainable province. Electrification of transport, then, assists with our ability to become a technology showcase and address long-term emission reduction goals.

Why would we need to be a testing ground? Electric vehicles involve additional electricity use, and with such increases, there are potential impacts. One favourable impact could be reduced GHG emissions from oil, particularly if these electric vehicles are accompanied with an increase in the amount of renewable electricity on our grid. PEI electricity imports and local generation have a good mix of emissions-free electricity from hydro, nuclear, and wind power, leading to much lower GHG emissions from electric cars than from conventional cars. However, a possible adverse impact is an increase in our peak load, if everyone charges their vehicles when they

[28] Tesla, "The week that electric vehicles went mainstream", https://www.teslamotors.com/blog, April 7, 2016.

get home from work in the early evening in winter. We must consider these types of potential impacts, both positive and negative, and test options for mitigating the negative ones and enhancing the positive ones. Because electric vehicles are not yet widely cost-effective, we have time to make these changes. Market forecasters anticipate that the cost of electric vehicles will continue to drop quickly, such that the cost of conventional and electric vehicles will be at parity as soon as 2022.[29]

Some innovative strategies for the integration of electric vehicles include harnessing vehicle batteries to manage our electric load, which can be done if their introduction is linked to smart grid measures that allow utilities to influence when car batteries are charged and to partially use vehicle batteries to store or withdraw stored electricity. ***We can therefore explore ways to link electric vehicles to a smart integration of car batteries, in cooperation with our electric utilities. We will also leverage funding options (such as Natural Resources Canada's funding allocated for electric vehicles and alternative transportation fuel infrastructure)[30] to build appropriate charging infrastructure.***

In addition, under current regulations, only utilities may sell electricity in PEI, so, for example, public electric car chargers must give away energy for free. This represents a barrier to further developing charging infrastructure. ***We will therefore explore and implement regulations to mitigate this impact, either allowing for electricity to be sold by other entities in limited ways, or else for utilities to become involved in charging infrastructure and then charge for the electricity withdrawn***. Under these models, the Province may be able to recoup losses from reduced gas tax revenues related to lower fuel consumption that can then be used to invest in additional new programs.

Government leadership in making its own fleets electric will provide a clear sign to Islanders about the value of electric cars. If we take action to accelerate the introduction of electric cars now, we will see positive benefits over the coming decade. As the graph above shows, even in 25 years, only 35% of new cars sold may be electric, absent a concerted effort to increase adoption. Because cars purchased today will remain on the road for anywhere from 10-20 years, we can make substantial gains by accelerating the trend towards electric cars. Given about 25% of cars sold in Norway today are electric, we believe we can also excel in this area as a Canadian province that both reduces fossil fuel use more quickly than others, and does so in a smart way that minimizes negative grid impacts and multiplies the value of electric cars to manage our electric grid.

The adoption of electric cars is affected by incentives, whether or not they significantly impact customers' payback periods. Therefore, introducing a monetary incentive could increase uptake on the Island, similar to other leading Canadian provinces. With an incentive offered in the near-term to kick-start the market and provide a strong policy signal, electric car sales in PEI could rise earlier than 2022, reducing our GHG emissions correspondingly. In addition, the Federal Government is providing $62.5 million dollars over 2016/17 and

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[29] Source: Bloomberg, "Here's How Electric Cars Will Cause the Next Oil Crisis", http://www.bloomberg.com/features/2016-ev-oil-crisis/

[30] http://www.nrcan.gc.ca/energy/science/programs-funding/18356

2017/18 to develop and demonstrate electric vehicle and alternative fuel infrastructure.[31] Investing in electric vehicles may therefore become one way we can leverage federal funding opportunities, which is a goal of this Strategy. In addition, to make EV adoption as easy as possible in our province, ***we will consider mandating that new homes be pre-wired for electric charging and link this measure to the adoption of the National Building Code. We will also examine the feasibility of requiring or encouraging outdoor parking in new multi-unit residential developments to be equipped with EV chargers.***

COMMERCIAL AND INSTITUTIONAL SECTOR

The business and institutional sectors can also be harnessed to promote electric and hybrid vehicles. For example, Purolator has already adopted hybrid electric and fully electric delivery vehicles in some of its fleets.[32] Such concepts could be expanded to other commercial fleets. Options for PEI include:

- The Provincial Government is already considering the purchase of electric school buses,[33] which would assist the electrification strategy and offers a special educational effect reaching school children and their parents. We will continue to support these types of options and considerations, also learning from previous trials of such buses in other jurisdictions.
- Electric light trucks, vans and delivery trucks [34] are also commercially available, albeit limited to distances suitable only for on-Island use for the time being.
- Harnessing taxis and rental car companies to move to electric cars would fit into a "green image" tourism strategy and also set a clear and visible example for Islanders to follow, due to the good visibility of these cars on the road. Taxis may already be cost-effective for EVs without incentives, due to their high annual kilometers driven. We will reach out to these stakeholders in terms of voluntary initiatives and examine the potential for public/private partnerships in order to facilitate the introduction of electric cars into these fleets.
- A made-in-Manitoba electric bus developed through a partnership between the Manitoba government, Mitsubishi Heavy Industries (MHI), New Flyer Industries, Manitoba Hydro and Red River College (RRC) can be recharged in about 10 minutes after each two-hour trip.[35] It has recently been tested in Winnipeg under winter conditions. Buses provide advertising space that could be used to promote electric and other sustainable transportation options. Public transportation is an area in which gains could be made in future years, so we will continue to monitor options that may become cost-effective for our context.

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[31] http://emc-mec.ca/activities/ev-roadmap/

[32] http://www.canadianshipper.com/features/purolator-launches-first-ever-fully-electric-delivery-truck/

[33] http://www.cbc.ca/news/canada/prince-edward-island/pei-electric-school-buses-1.3537505

[34] e.g., http://www.viamotors.com/vehicles/electric-truck/; http://www.smithelectric.com/; http://lionbuses.com/en/lion-store/

[35] http://winnipegtransit.com/en/major-projects/electric-bus-demonstration/

Action Items

- Develop an appropriate incentive for buying electric vehicles.
- Leverage federal funding investments to increase public charging infrastructure.
- Consider mandating EV charger pre-wiring in new homes.
- Examine the feasibility of requiring or encouraging chargers at outdoor parking in new residential developments.
- Lead by example by purchasing electric vehicles for government operations.
- Reach out to car rental and taxi companies to introduce electric vehicles as part of a green tourism strategy.
- Consider the introduction of electric school buses.
- Reach out to businesses to facilitate the adoption of electric delivery trucks.

BIOGAS

Based on some of the key feedstocks for anaerobic digesters on the Island, over 1.4 million litres of diesel used in Prince Edward Island could be displaced with natural gas made from biogas (see Table 5). The overwhelming majority of this fuel would be developed from high solids digestion of the organic waste currently being composted at the Central Composting Site. While this is only about 1% of on-Island diesel sales, it should be enough to power the Island's garbage collection truck fleet, as is being done in other jurisdictions.[36]

Since compressed natural gas (CNG) garbage trucks displace an estimated 35,500 litres of diesel fuel and result in a reduction of 22 metric tonnes of greenhouse gas emissions per year, per truck,[37] ***Island-produced biogas could displace about the same amount of diesel as the 41 Island Waste Management Corporation's[38] garbage transportation trucks*** (1.4 million litres of diesel).

Although biogas use will not significantly reduce fossil fuel use for heavy-duty trucks, it is an important component in an overall energy strategy to replace diesel with cleaner-burning natural gas for commercial transportation. Companies are already importing compressed natural gas (CNG) to the Island for industrial use. For example, since 2011, Cavendish Farms uses it to provide heat,[39] replacing the previously used heavy oil.

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[36] For an example, see Surrey, BC: http://www.surrey.ca/city-services/13015.aspx

[37] For example, see the Waste Management fleet in California: www.cumminswestport.com/content/621/Waste-Management-Fleet-Profile-EN.pdf

[38] Note that the trucks belong to contractors, which reduces the corporation's control over the fuel they are using, so discussions would need to involve the contractors.

[39] Amalgamated Dairies also uses Irving's natural gas for heating, see http://www.theguardian.pe.ca/Business/2014-01-19/article-3580810/ADL-converting-Summerside-plant-to-natural-gas/1

Table 5. Potential Diesel Displacement from Locally Produced Biogas

Source	Amount per year	Biogas/methaneyield	Total Annual Potential	Diesel Displaced[5]
Organic waste	20,000 tonnes[3]	60 m^3/CH_4 tonne[4]	1,200,000 m^3	1,249,000 l
Cattle	65,000 heads[1]	2.0 m^3/d each[2]	130,000 m^3	67,000 l
Hogs	60,000 heads[1]	1.9 m^3/d each[2]	114,000 m^3	59,000 l
Poultry	Unknown	0.85 m^3/d per 100[2]		

[1] 2012 StatsCan data, CANSIM Tables 003-0083, 003-0102
[2] Government of Alberta assumptions http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10945
[3] Annual amount received at Central Composting Site (2014 IWMC Annual Report)
[4] Harvest Power (MSW PROJECT OPPORTUNITY, Slide Presentation, 2013)
[5] Compared to diesel, based on energy content; assumes methane content of 50% in biogas

Both municipal organic waste and agriculture-related residues can be used to produce biogas. Following the example of other jurisdictions that have implemented high solids digesters, including many places in Europe, we will examine the feasibility of implementing an anaerobic digestion facility at the Central Composting Facility and biogas processing to produce synthetic natural gas to fuel our provincial garbage collection fleet.

Action Item

- Assess the feasibility for producing biogas from organic waste and other sources, to produce a vehicle fuel to operate the PEI waste truck fleet.

COMPRESSED NATURAL GAS

Since larger trucks cannot currently be electrified, a different technology is required if meaningful reductions of diesel use by such vehicles are to be achieved in the context of our energy and GHG reduction goals. Natural gas, a much cleaner fuel than diesel, can be used as a fuel in trucks, but this requires either retrofitting diesel trucks with natural gas engines and reservoirs, or the purchase of new vehicles. Retrofitting is not likely cost-effective, so any CNG options for diesel trucks should focus on new purchases only. Fewer than 700 trucks from PEI are registered under the International Registration Plan and are therefore assumed to leave the Island regularly on their trips. Flex-fuel trucks are available that could use both diesel and natural gas but generally, adoption is likely lower among trucks traveling off Island. Some routes across Quebec and Ontario may offer enough CNG refilling stations to enable the use of CNG trucks on these routes, and others may be added in the future to also enable other routes. On the whole, most trucks operate on the Island and could therefore move to CNG if a refilling infrastructure is built over the coming years.

However, using similar calculations to electric vehicles, assuming that most of the 25,000 trucks could currently move to CNG and that 5% of them are replaced with new ones each year, the potential market for CNG trucks in PEI would be 1,215 vehicles per year. Further assuming the annual distance travelled for each truck is about 32,000 km and that trucks have a fuel efficiency of 2.5 km/litre, a total of 12.4 million litres of diesel could be displaced within a decade (see Table 6). This represents about 16.5% of total diesel sales in 2013.

Table 6. Potential Diesel Displacement from CNG Trucks

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
% of CNG truck sales/new truck sales	1%	4%	8%	16%	24%	32%	40%	48%	64%	80%
# of CNG trucks sold per year	12	49	97	194	292	389	486	583	778	972
Diesel displaced (1000 L)	156	622	1,244	2,488	3,732	4,977	6,221	7,465	9,953	12,442

In order to replace diesel use in heavy transport, we will examine policies for converting larger trucks to compressed natural gas use. CNG is cheaper than diesel[40] and most research shows it does not have the same emissions profile – notably, it fits better with a GHG strategy, given it produces fewer carbon emissions.[41] This approach links in with biogas use for transportation but can achieve much higher diesel substitution than biogas could on its own. Incentives[42] may be required to facilitate CNG vehicle adoption during the initial years.

[40] At 75 ¢/(L, diesel costs almost $20/GJ. Bulk natural gas currently costs around $3/GJ, and delivered CNG would still be competitive with diesel at $10/GJ and more.

[41] Note there is some controversy around life-cycle GHG emissions from natural gas and propane. The GHG Protocol's guidance "Calculating CO_2 Emissions from Mobile Sources" lists LPG and CNG tailpipe emissions as about 85 and 75% those of diesel, respectively. According to a study of Argonne Labs, CNG in trucks can be expected to reduce GHG emissions by about 25% (see www.ngvamerica.org/natural-gas/environmental-benefits/), but only if upstream fugitive methane emissions are well contained.

[42] For example, California's Natural Gas Vehicle Incentive Project (NGVIP), administered by The Institute of Transportation Studies at University of California Irvine, provides incentives of up to US$25,000 towards the purchase of natural gas trucks.

Alternatively, voluntary targets could be set in cooperation with PEI fleet operators, or a low-emission fleet standard could be legislated that gradually reduces the allowable soot and/or GHG emissions from trucking fleets over time, encouraging a gradual replacement or diesel trucks.

Although natural gas is much cheaper than diesel on a gigajoule basis, considerable investment in storage and dispensing infrastructure would be required to implement such a concept in PEI. ***The potential for using CNG as a vehicle fuel should therefore be examined through a more detailed feasibility study***. Such a study could also explore diesel-electric hybrid vehicles and propane use instead of, or as a parallel strategy to, CNG use. On a life-cycle basis, liquefied petroleum gas emissions may, however, be very similar to those of diesel fuel.[43]

Action Items

- Work with industry to conduct a feasibility study on CNG use for trucks in PEI.
- Consider the introduction of a fleet-based low-emissions standard for truck operators on the Island.

MOBILITY MANAGEMENT

As mentioned earlier in this Strategy, several measures addressing transportation energy use are already being implemented to some degree in our province. These are aimed to a great degree at reducing the amount of vehicle-based travel and at mode shifting to more sustainable options. Current initiatives include improving traffic flow, discouraging the use of cars in city centres, changing driving styles, telecommuting, creating pedestrian zones, etc. Such measures can be pursued for additional reasons, such as public health (e.g., encourage walking in city centres and malls, bike lanes, etc.) or to promote sustainable lifestyles and create a green image for the Island as a tourism destination.

Whichever specific options we consider now and into the future, when we calculate their costs, we must consider their direct as well as indirect benefits. For example, shifting our current driving culture to a cycling one will reduce road maintenance costs and reduce congestion. Although we have already implemented many of these types of measures, they could sometimes be intensified or expanded to achieve lasting long-term results. The new Municipal Planning Act may offer an opportunity to guide municipalities in their transport planning. More details are provided in the Additional Considerations section of this Strategy.

We are currently expanding our bike lane network. One option we should consider is a comprehensive network of paths and roads that are intended to stretch bike use for commuting further than cyclists are usually willing to commute (about 5 km). In addition, electrically assisted bikes may further expand the use of these lanes. Examples that we can further research include the *Blue Route* in Nova Scotia, Dublin's (IE) efforts,[44] or the

[43] LPG's Carbon Footprint Compared to Other Fuels – A Sceintific Review. Atlantic Consulting, 2009

[44] http://www.eltis.org/discover/case-studies/greater-dublin-areas-ambitious-cycle-network-plan-ireland

German 5-meter-wide "bike highway" concept.[45] An enclosed bicycle could even be used in winter if bike lanes are cleared of snow.

Why invest in an option like this without an existing cycling culture? Bike infrastructure costs less money than improving streets for cars and has been shown to increase the number of cyclists. This is due, in part, to the fact it takes away a major fear of cyclists of being hit by a car. Our temperate climate is also conducive to such strategies.

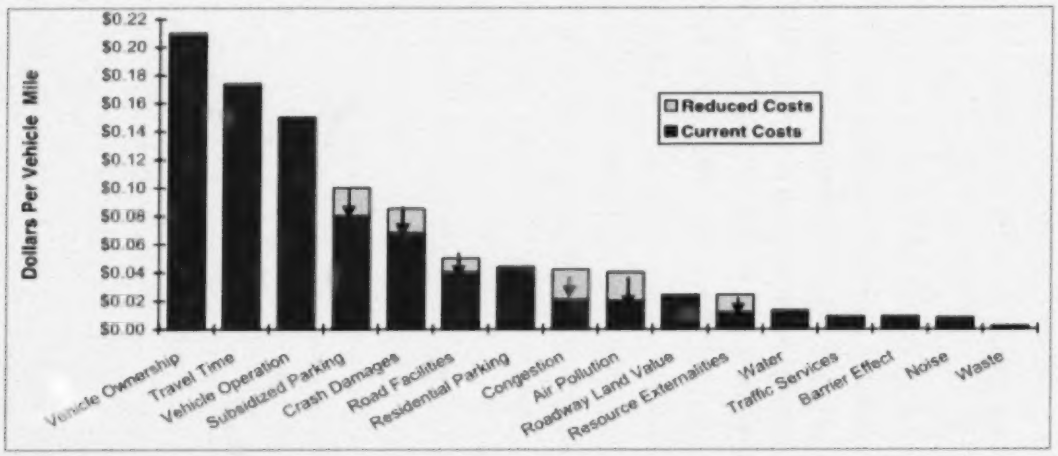
An even more comprehensive bike lane network could be developed throughout the Island as an eco-tourism attraction. The existing Confederation Trail and branch extensions already serve this purpose and could be expanded to include coastal roads, dirt and heritage roads, and inner city areas to offer safe and dedicated bike lanes for both Islanders and tourists. We understand that people are attached to their vehicles. However, we can also promote bicycle use for commuters (and public transportation) by restricting the number of parking spaces that businesses and institutions can provide,[46] also putting the onus on employers to promote other means of transportation.

In terms of cost-effectiveness, these types of options are some of the most cost-effective ways we can reduce our GHGs. They are a form of energy efficiency and conservation; they involve reducing our fuel consumption and using it more effectively when we need it. Hence, similar to energy efficiency, we should take a societal view when evaluating the costs of expanded and new programs and investment. Figure 16 below provides an overview of how reduced car use reduces societal costs. For example, with reduced personal vehicle use, the number of accidents or required parking spaces are also reduced. These are reflected in the light-blue sections of the bars below. Full-cost accounting will often show that investment in alternative transportation is more cost-effective than enhancing conventional transportation modes.

[45] https://www.greenbiz.com/article/beyond-autobahn-germanys-new-bike-highways

[46] Restricting parking spaces can incent modal changes in an additional way by offering a parking cash-out, in which commuters who use alternative modes receive the cash equivalent of parking subsidies.

Figure 16. Comparison of Options for Reducing Societal Automobile Costs[47]



Note: Figure 16 illustrates estimated impacts of reduced vehicle-mileage. Downward arrows indicate reduced costs per mile not driven.

Some of the measures proposed to address the transportation sector should be pursued in the context of a sustainable urban development strategy. Others can be pursued in combination with other options that are researched and implemented in the next ten years. For example, when developing a regulatory framework that will maximize the benefits and minimize the potential implications of electric cars, other strategies can also be discussed and implemented, leading to a mid-term paradigm shift as to how PEI citizens and companies think about energy and the environment, and providing a cultural basis for our province to become and stay a leader in sustainable transportation and energy use. [48]

In this Strategy, we intend to pursue some key actions related to transportation. However, we do not define all the details of the policies proposed. This is because a focus on non-vehicle transportation options is so new, and not part of the culture on the Island, that we do not, and cannot, know the ones that will be optimal for Island residents and businesses. Nevertheless, we are committed to making this change. ***We will therefore commission a specific sustainable transportation strategy that will examine other jurisdictions and evaluate various approaches, including financing options, and adopt those that make sense in the PEI context***. Attention should be given to the way measures are implemented to obtain a maximum of success in terms of social acceptance and effectiveness, removing administrative barriers and integrating long-term sustainable thinking into all transport planning decisions. Collaboration with municipalities and our regional neighbours may help us to identify the best and most suitable transport technologies and solutions.

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[47] Source: Todd Litman, Smart Transportation Emission Reductions. Victoria Transport Policy Institute, 2015

[48] Todd Litman, *Smart Transportation Emission Reductions*. Victoria Transport Policy Institute, 2015.

ENHANCING OUR CULTURE

As part of a strategy to create a "green identity" for the Island, we need to work together to determine our future in regards to behaviour change. Specifically, we need to begin working with municipal governments, institutions and businesses to create a set of tools and measures to enhance sustainable transportation on the Island. ***We propose to create a sustainable transportation committee to address this type of cultural change and to examine infrastructure options such as cycling lanes, public chargers, parking areas, and others. The committee would be supported by an annual budget.*** While the committee would determine its own initiatives, some examples of topics to explore include:

- Maximizing the promotional value of electric transit and school buses, government fleet cars, and possibly taxis and rental cars, as well as using other promotional means to create a culture that favours electric transportation.
- Introducing a rewards (points) system that would allow PEI citizens to collect points for using more sustainable transportation options (ride sharing, cycling, public transport, electric cars),[49] or for using better driving practices, ride sharing, etc. This could be linked to an existing rewards program or set up as a separate program. See Figure 17 for some examples.
- Initiate commuter ride-share programs (linked to a rewards program) at the provincial, municipal, and company levels.
- Conduct pilots and trials, such as offering E-bikes to commuters currently coming by car.
- Support companies in their own efforts to encourage employees to use alternative means of transportation to get to work.

Figure 17. Examples of Reward Programs

Rewards for Sustainable Choices
San Diego, Los Angeles and Orange County, CA are working with *My Open Road* (MOR), which manages a smart phone app that links people's sustainable transportation choices with a rewards system. In April and May 2016, MOR held a competition between the three municipalities, for which the person reducing carbon emissions by the largest amount could win a $2,000 cash prize. The app for Android and iOS tracks modes of transport (carpooling, EVs, biking, walking and skateboarding) and allows users to record the amount of carbon emissions they save in order to obtain freebies and discounts. It also assigns a corresponding "Social Responsibility Score". Using smart electronics, social enterprise *Zerofootprint* aims to create a generation of conscientious citizens through "awareness, education, community engagement, incentivization and rewards." GOODcoins can be obtained based on measured behaviour and redeemed for products from selected brands.

In addition to developing made-in-PEI solutions, the committee can also monitor innovative practices from other jurisdictions. Although large cities have higher population densities than our province, several are adopting concepts that may also serve us in the longer term. The Finnish capital Helsinki plans to create a public

[49] e.g., Air Miles for Social Change; Air Miles rewards for recycling (https://www.airmiles.ca/m/SponsorDetails?sponsorId=1120775120630) ; www.myopenroad.com; https://global.goodcoins.ca

transportation network combining driverless cars, rental bikes, and small buses into an integrated network that can be accessed by smartphone with a single ticket and would make car ownership unnecessary. Altamonte Springs, an Orlando suburb, is the first American city to pay a portion of the fare for all trips with Uber within its limits to avoid a costly bus system. Another example is the Rocky Mountain Institute working with the Cities of Denver and Austin to create alternative transport options, mainly based on a mix of transport modes linked through cell phone apps and a sophisticated information system.

While we are aiming at electrifying our car fleet, we will consider reducing emissions from gasoline and diesel vehicles (including commercial vehicles) by introducing an emissions control system, as exists in other provinces. By making sure cars are well-tuned and perform as designed, we can achieve incremental emission reductions while these cars are still in circulation.

In addition, car registrations in PEI are currently subject to a flat fee of $100, notwithstanding the type and size of car. Registration fees and gas/diesel pricing do not fully reflect road maintenance and construction costs, as well as health expenses caused by motor traffic.[50] One approach to reducing car use would therefore be to increase fees and fuel taxes, and grade registration fees as a function of vehicle size. Such an approach needs to be introduced gradually in order for the public to make informed and considered medium-term decisions about transportation options. Making such changes incremental and overall revenue neutral (such as the BC Carbon Tax, which reduces other taxes to create a balance) may increase social acceptance for more fully accounting for the cost of driving. We will begin to explore this type of option for the purposes of inducing cultural change.

Action Items

- Continue and enhance the build-out of cycling lanes across the Island.
- Continue implementing longer-term strategies to make traffic more efficient and to reduce transportation energy use.
- Work with QUEST and/or other Atlantic governments and agencies to identify strategies and technologies to enhance regional sustainable transportation on an on-going basis.
- Develop and maintain a long-term culture-change effort to transform attitudes around transportation and commuting and promote sustainable transportation options. This effort should be part of a larger "green image" and "sustainable lifestyle" strategy that includes tourism.
- Create a provincial transportation committee that is supported by an annual budget.
- Commission a dedicated Sustainable Transportation Strategy to guide the Committee's work in implementing the Energy Strategy recommendations.
- Introduce regular emissions controls for all vehicles fuelled with diesel and gasoline.
- Consider reflecting the cost of driving, as well as of different types of vehicles, in registration fees and/or fuel taxes.

[50] See, for example, Fig.2 in Todd Litman, *Smart Transportation Emission Reduction Strategies* (2015) to illustrate the external costs of driving

FURTHER CONSIDERATIONS AND OPPORTUNITIES

MUNICIPAL PLANNING REQUIREMENTS

One key area of leadership we can provide is completely within our own boundaries. With only 10% of the Island covered under the Municipal Planning Act, the Province needs a solid partnership with municipalities to ensure we are all on the same page. Therefore, a key area for this Strategy that impacts all sectors, is to develop and enhance our municipal planning considerations to include energy concerns and reduce barriers to energy-conscious and efficient development. For example, we can:

- Research and implement land-use by-laws requiring renewable energy content.
- Require developers to obtain a given number of "points", whether for energy efficiency considerations; being "solar ready"; implementing options to reduce peak, including carbon-neutral technologies for heating rather than electric heat; district heating options; and others.
- Collaborate on transportation and urban planning considerations.
- Examine opportunities for increasing our use of biomass and community heating or solar options when infrastructure upgrades are being made.

Action Items
• Incorporate energy-related topics into municipal planning discussions in collaboration with municipalities.
• Implement legislation to discourage and potentially remove the ability to pass bylaws that counter-act energy efficiency or renewable energy efforts. Examples include, but are not limited to, communities not allowing clotheslines or the siting of houses to take advantage of solar potential.

PROVINCIAL PROCUREMENT STANDARDS

Our Provincial Government, and our Municipal Governments, must be actively involved in this Strategy for it to succeed. One way to do so is to implement procurement requirements that require tenders to address sustainability considerations. Points can be awarded for sustainable actions or policies undertaken by proponents. For example, when contracting for transportation services, tenders could adopt an evaluation method that gives extra points for freight companies that are members of a green fleet program or can demonstrate their efforts to reduce fuel use and introduce cleaner technologies. A strong push in this direction can be created when provincial, federal, and municipal governments use similar methods to select "greener" service providers.

Action Item
• Develop and implement sustainable-energy-related criteria into Government tender requirements and scoring.

FUEL COST DIFFERENTIAL

Biomass, particularly wood pellet furnaces, and electric heat provide clear opportunities for replacing unsustainable fossil fuels. Biomass can also be used to mitigate increasing concerns about winter peak electricity demand related to the shift towards electric heat. However, the price differential between oil heat and renewable, sustainable resources needs to be addressed.

As Table 7 shows, the current price differential between oil and heating alternatives is small, because it does not take into account the negative long-term health and environmental impacts of oil production and use. Pellet boilers with greater efficiencies have a cost advantage, but a new oil boiler could have similar efficiencies as well. A key reason for this fuel price differential is that HST is applicable to all fuels except for oil, on which only GST is charged. The intention of this reduction in taxes on oil was to address the high cost of heating homes for a majority of Island residents, including low-income homeowners and renters.

Table 7. Current Cost of Residential Heating in PEI

Heating Type	Efficiency	Cost of fuel	Cost per GJ delivered*
Electric baseboard	100%	$0.13/kWh	$41.17
Baseboard with mini-split heat pump**	150%	$0.13/kWh	$27.44
Oil central heating, old	75%	$0.76/L	$28.53
Pellet stove, EPA certified	75%	$6/bag (40 lb)	$29.80
Pellet boiler, new (central heating)	85%	$330/t	$26.03

* Includes applicable sales taxes.

** Assumes approximately 30% of load is displaced by mini split (250% efficiency). Many homes experience a greater percent of load being displaced, but 30% is considered a conservative minimum for assuming savings values for homes that may not install or maintain their heat pumps appropriately. Homes displacing more load would see even lower costs than the ones shown here.

Action Item
• Develop incentives for Islanders to switch from oil heat to more sustainable options with acceptable emissions and/or environmental controls.

RATE STRUCTURES

The electricity rates set in the province are standard, stable, and carefully crafted to ensure customers receive equitable treatment and fair value. However, increasingly, they may not be meeting the needs of changes in the structure and delivery of electricity. Distributed generation (rooftop solar, for example), high (and increasing) peak demand, variable wind output, and the availability of smart meters and energy management systems are all functions of our time that were not around when today's rate structure was developed. For example, Maritime Electric is the only electric utility in Canada with a residential declining block rate. This structure can reduce customers' willingness to engage in energy efficiency programs, which are important for achieving the goals and principles of this Strategy.

Similarly, except for customers enrolled in Summerside Electric's "Heat for Less Now" program, residential customers are billed at a fixed per-kWh rate. However, at a time in which peak demand is becoming a concern, increasing rates at the expected time of system peak can have positive benefits to our system (e.g., between 5pm and 8pm). ***Similarly, smart meters could allow for time-of-use pricing that encourage electricity consumption (such as charging electric vehicles or running a clothes dryer) during periods of high wind power and low demand and discourage it during periods of low wind power and high demand.*** A different, but related issue, is the need for appropriate communications systems for the smart meters. Building a utility-only communications system may not be cost-effective. ***We recommend conducting research into options for integrating the communications requirements of smart meters across all utility customers.*** Such research could include rental options of bandwidth from telecommunications companies (that would continue regardless of the customer's choice of provider) or other options.

Customers are also undersizing their rooftop and ground mount solar systems, partially because we have net metering (customers pay for the difference in kWh at a given point in time between they electricity they consume and the electricity they produce) rather than net billing (customers can sell to the system however much they produce and consume however much they need). To avoid paying more for a "right-sized" system that *may* overproduce electricity that is a lost opportunity, customers purchase systems that do not meet all of their electricity needs.

This Energy Strategy is not recommending specific rate structure changes to our electricity system. That is a far larger discussion that must occur with our utilities, regulator, and Government. However, we would be remiss if we did not address changes in the way electricity is generated and distributed, and the impacts that can have on how we pay for electricity. As mentioned in the Solar section of this document, some utilities have had to restrict customers from participating in Solar programs because of the negative impacts on remaining customers, which is also not necessarily equitable.

For these reasons, we need to begin discussions on potential rate structure changes now, rather than waiting for negative impacts to occur in the future. These discussions must be informed by multiple perspectives and considerations, including utility-level, customer-level, and societal-level.

Action Items

- Initiate discussions and research (as required) on potential rate-structure and billing changes that acknowledge expected future changes to the electricity system over the coming years.
- As meters are replaced or relevant technology such as ETS or solar/storage units are installed, install smart meters to allow for a future time-of-use billing system.
- Research options into meeting the communications requirements of a province-wide rollout of smart meters (and institute a process to ensure that both utilities have a common smart-metering approach and/or systems, if possible).
- Develop, in collaboration with Maritime Electric, an appropriate replacement schedule for all meters that will allow the Island to implement a smart-grid system to better integrate renewable technologies and a distributed generation system.

GOVERNMENT PLANNING

While many of the inclusions in this Strategy involve residents and businesses across the Island, there is a role for Government to play in leading by example. For this reason, we also believe we should begin including environmental and social costs and benefits in all energy and climate-change-related calculations. For example, if we continue to build facilities for the lowest-possible upfront cost, rather than factoring in ongoing operations and maintenance costs or the harm to society from added pollution or health-care costs, we are not investing in our future.

In developing this Strategy, we worked to ensure that the actions we take are cost-effective and will provide overall benefits to our province. However, this type of assessment often only includes short-term or narrow economic considerations. Understanding the impacts of our decisions on Islanders' health, climate, environment, and others should be included in our future decision-making and analyses. While this Strategy has not quantitatively included these types of societal benefits because a methodology for Prince Edward Island has yet to be adopted, it is an important consideration in the future. We have addressed the need for a societal perspective in several areas of this Strategy; however, even if not explicitly addressed elsewhere, our future decisions would benefit from doing so. This would also be expected to increase the cost-effectiveness of the Action Items.

Action Item

- Initiate a process to develop high-level calculations for life-cycle costing and societal considerations that will be used to inform purchasing, capital, and other Provincial Government decisions.

LOOKING TO THE FUTURE

Energy is a critical component of our lives, but it is also one in which we can end up on a path without having ever considered how we got there.

Prince Edward Island's Provincial Government, through its Energy Corporation, is taking steps to ensure we know where we are headed and why we are going there. But we are not the only ones:

- Our utilities are working every day to ensure we have reliable, stable electricity.
- Solar installers and wind power developers are making our system more sustainable.
- Efficiency PEI is helping us reduce our electric and non-electric energy consumption and saving us money.
- Municipalities are working to reduce barriers to sustainable energy use and community development.
- Residential and commercial customers are providing us input and feedback about directions we should consider.
- And many, many others think, talk, and engage in a myriad of ways about our energy future: through committees, conversations, letters, and meetings.

This Provincial Energy Strategy has been developed with your input and perspectives. We have identified our guiding principles: reducing greenhouse gas emissions, seeing a more cost-effective long-term approach, and developing local capacity. We have considered ways to leverage our small size and innovative spirit. And we have developed actions that are required for us to achieve our goals. We *can* become a national and even global leader through the implementation of this Strategy:

- We are already second in the world in our integration of wind energy per capita. We have an untapped wind regime and the experience to utilize it to become a leading exporter of wind energy.
- Energy storage will change our energy system in incredible ways. By unifying the Wind Energy Institute of Canada's existing and developmental storage programs with our electrical system and the emerging expertise of both UPEI and Holland College, we can become leaders in the area of energy storage.
- Our waste management program is proof of our leadership in sustainable programs and options. "Small" can be, and has already been shown to be, "great". But we won't rest on our laurels. We will follow this example in our aggressive levels of energy efficiency and conservation and in deploying Island-wide Energy Thermal Storage (ETS). Our geography and island culture are perfectly matched to suit both initiatives.

Our leadership and initiative will work towards mitigating climate change – our Action Items are all designed to do just that. But we will also achieve additional success:

- We will reduce our GHGs.

- A net addition of over 400 full-time equivalent jobs per year is possible, with the potential for even higher numbers based on our success and some of the results of the studies and initiatives being proposed.
- Electricity will become the predominant energy source on the Island, replacing imported fossil fuel energy and keeping more of our hard-earned dollars here.
- We will meet our energy needs in a sustainable and renewable manner. Rather than an electricity deficit, we will have a surplus of electricity we can export for the benefit of all Islanders.

While the Government of Prince Edward Island has ultimate ownership of this Strategy and its implementation, one entity cannot accomplish it all. We look forward to working with First Nations, residents, businesses, subject-matter experts, and others throughout the ten years of this Strategy and accomplishing these goals together.

Through the implementation of this Strategy, we are putting ourselves on a path to become a leader in sustainability and renewables. We are looking towards the future, rather than the past, and by doing so, will harness the power of our strengths in meeting our future energy needs.

APPENDIX A – CONSIDERATIONS FOR DEVELOPING WOOD PELLETS

- **Avoiding early failures:** only proven boiler and furnace systems that have a good track record[51] should be installed. This also means installers must be well trained in order to avoid incorrect installation and wrong system dimensioning (oversizing has been a problem with many boilers installed in Canada's north). It also pertains to pellet quality, which needs to be of the *Premium A1* standard.

- **Achieving critical mass:** government and large commercial customers can become "anchor customers" that allow for a local pellet storage business to establish itself.

- **Promotion:** it is important to promote pellet central heating (as opposed to pellet stoves) so that people become familiar with it and consider it whenever the time comes to replace an old heating system. Promotion can occur through TV ads (e.g., Maine), billboards, etc., but also through government support programs. A 30% capital cost subsidy is what most government programs currently offer in Europe and the US. Massachusetts offers 50%.

- **Peaking heat:** Often, pellet boilers will be sized to provide base load but not all peak heating needs during the coldest winter nights. Peak heat can be provided with secondary electric heating. However, this is not optimal for our current capacity constraints, so a backup boiler (usually the existing oil boiler) should be used for peaking. For residential systems, a good quality pellet boiler or furnace should be able to fully replace oil, including peaking needs.

- **Two sources:** The local pellet provider should source pellets from two different sources (e.g., Quebec and Nova Scotia) in order to minimize the risk of supply interruptions.

[51] Dutch Dresser of Maine Energy Systems (Personal communication, April 14, 2016) does not recommend using the cheaper Danish systems mentioned above since their reputation in Maine has been to require frequent troubleshooting. Systems should have a previous Canadian track record and should be in compliance with CSA 365-10 (for larger boilers). Residential systems should have an automatic ash removal system.

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